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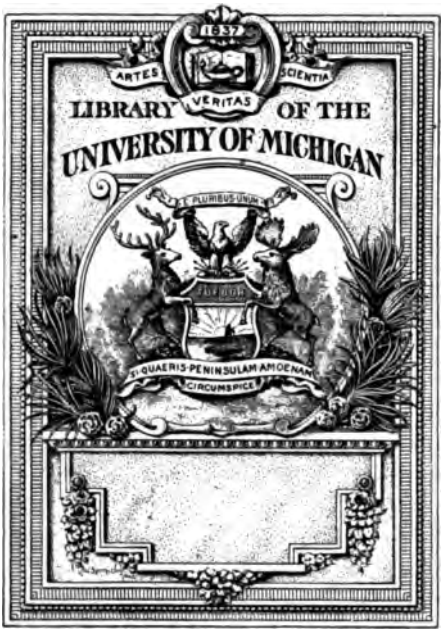
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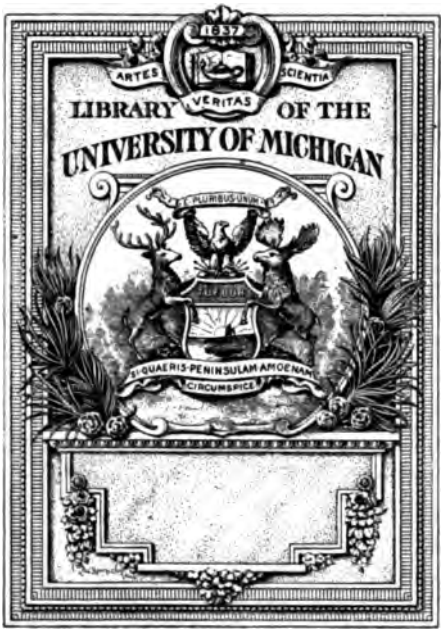
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TRANSACTIONS

OF THE

ROYAL
SCOTTISH ARBORICULTURAL SOCIETY.

LIEUT.-COLONEL F. BAILEY, F.R.S.E.,
HONORARY EDITOR.

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ASSISTANT EDITOR.

ROBERT GALLOWAY, S.S.C.,
SECRETARY AND TREASURER.

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TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

I. *Timber: Its Strength, and How to Test It.*[1] By T. HUDSON BEARE, M.Inst.C.E., Regius Professor of Engineering in the University of Edinburgh.

A very large number of experimental observations on the strength and other properties of the various kinds of timber which are used by engineers, architects, and builders has been published in the proceedings of various technical societies, in technical journals, and in text-books. Unfortunately, many of these older tests are unreliable, and if the data deduced from them are employed in calculations, considerable judgment is needed before such data can be adopted with safety. Justification for such a statement is to be found in the following facts:—

1. In no case, so far as I know, in these older experiments was any attempt made to determine the moisture present in the timber at the time the test was carried out, and in very few cases were data given as to the time of felling, the length of time during which the timber had been seasoned, etc.; now the amount of sap or moisture present in timber is a very vital factor in determining its mechanical properties.

2. Owing to the fact that the apparatus at the disposal of the experimenters was not sufficiently powerful to make any other method possible, the tests were mainly made upon very small specimens, usually selected with great care on account of their freedom from knots and other blemishes; the results are, therefore, not really representative of the average quality of the particular kind of timber the specimens were supposed to represent.

To the late Professor Bauschinger is due the credit of instituting a really scientific method of carrying out tests of timber,

[1] Lecture delivered before the Dundee Institute of Engineers, November 17, 1904.

in which careful records were kept not only of the moisture conditions, but of the previous history of the wood from which the specimens were prepared. Professor Bauschinger carried out at Munich, in 1883 and in 1887, two classical researches upon this subject, and the results obtained were published in *Mittheilungen aus dem Mechanisch-Technischen Laboratorium der K. Technischen Hochschule in München*, in 1883 and 1887. These original publications should be consulted by anyone anxious to learn the exact way in which these experiments were conducted, but the substance of the results obtained is given in Professor Unwin's work on the *Testing of Materials of Construction*.

One of the earliest points in the research was the determination of the influence of the moisture present in the sample of timber upon its compressive and bending strength. The method adopted by Bauschinger for determining the dryness of his specimens was as follows:—sawdust, or small chips from the actual specimen, was carefully dried in a current of warm air kept at a temperature of about 212° F., and maintained for about eight hours: the sample of sawdust or chips was weighed carefully before subjection to this drying current, and immediately afterwards; the difference of weight in the two weighings gave, therefore, the amount of moisture present, and therefore its percentage in terms of the dry weight of the sample. In his later research Bauschinger adopted, in preference to this plan, the method of drying the whole tested specimen for a period of from two to four days in an oven, where the air temperature was maintained at 212° F., as in the previous method, and again the difference between the weighings before and after the specimen had been placed in the oven gave the total moisture present in the entire specimen. This second method is no doubt a better plan, because any local differences in the moisture present in the specimen are eliminated, but it is a little more difficult to ensure uniformity of dryness throughout the whole specimen, unless the specimen is kept in the hot-air oven for a considerable length of time.

I may point out here that timber thus artificially dried very rapidly reabsorbs moisture from the air, and, in fact, timber which has been used and kept in a well-warmed, dry house for a long period of time would probably have as much as 10 per cent. of moisture present in it. It is, therefore, not

possible to carry out the actual tests on perfectly dry specimens, since, if the specimens were perfectly dry before the tests began, they would rapidly reabsorb moisture during the time the experiment was being carried out.

In order to be able to compare results of different tests, it is desirable that a standard of dryness should be adopted, and Bauschinger, as the result of his research, recommended that all tests upon timber should be reduced to a standard of 15 per cent. dryness.

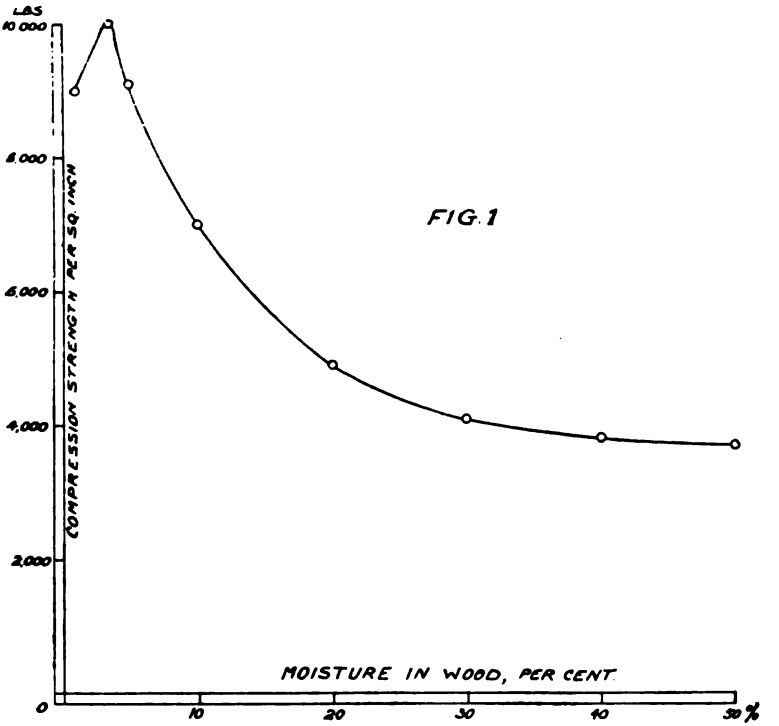


FIG. 1

To reduce results to such a standard, it is clear that we must have for each quality of timber a definite numerical law, connecting together the mechanical strength and the percentage of moisture present. This law can be experimentally determined by making tests of a number of samples of the same quality of timber with different percentages of moisture in the different specimens.

Fig. 1 shows the plotted results of such an experiment

carried out in America on specimens of short-leaf, or yellow, pine (*Pinus echinata*, Mill.) sap-wood. The vertical ordinates give the crushing strength in lbs. per square inch, and the horizontal abscissæ give the percentage of moisture in the different specimens. It will be observed that the strength falls off exceedingly rapidly in the same quality of timber as the percentage of moisture increases; and further, it is interesting to note an important point in connection with this law of variation of strength with variation of moisture. When the moisture reaches about 40 per cent., any further increase appears to have but small influence upon the strength of the wood; this is due to the fact that any increase in the moisture present beyond about 40 per cent. merely fills up the empty cell-spaces with moisture, and this does not affect in any way the strength; it is the wetting of the cell-walls by the first portion of the moisture absorbed which is injurious and reduces the strength of the timber.

The equation to the curve shown in Fig. 1 at once enables the strength at 15 per cent. moisture to be calculated, when the strength at some other percentage of moisture has been experimentally determined.

Another good series of thoroughly scientific tests upon timber was that carried out on behalf of the Forest Department of the Board of Agriculture of the United States, between the years 1891 and 1895. In this great series of tests the mechanical experiments were carried out mainly by Professor Johnson of Washington University, St Louis, U.S.A.; while the microscopic and other examination of the cellular structure of the woods was carried out at Washington itself. The experiments were carried out on wood specimens prepared from about three hundred trees, embracing about ten different kinds of pine or needle-leaf trees, that is, soft woods, and about five different kinds of broad-leaf trees, or hard woods, of the United States; and when each tree was felled, an accurate record was kept as to the condition of the soil in which the tree grew, the climatic conditions of the district in which it grew, the size of the tree, the conditions of its growth, the age of the tree, and the date of felling. You will see, therefore, that most careful records were kept not only of what happened during the actual tests, but of the previous life-history, so to speak, of the trees from which the samples were prepared, and, unless such a record is kept, the value of the research, from the

point of view of forestry, is almost entirely lost. It is only by such elaborate records that those responsible for the upkeep and the maintenance of State forests can obtain data upon which they can work in the management and treatment of the trees in the forest, and of course it is equally important to the engineer and to the architect to know, when he has the data of the tests before him, what was the previous history of the timber from which the specimens were prepared.

As in Bauschinger's tests, so also in those of the American Board of Agriculture, careful determinations were made of the moisture conditions of the tested bars. The plan adopted by the American observers was to cut a thin disc across the whole section of the tested bar, as close up to the point of fracture as possible; these thin discs were then at once weighed, and immediately placed for a number of hours in a warm current of air, maintained at a temperature of 220° F.; they were then re-weighed when perfectly dry, and the difference between the two weighings gave the total moisture present, and the ratio of this difference to the dry weight was the percentage of moisture present.

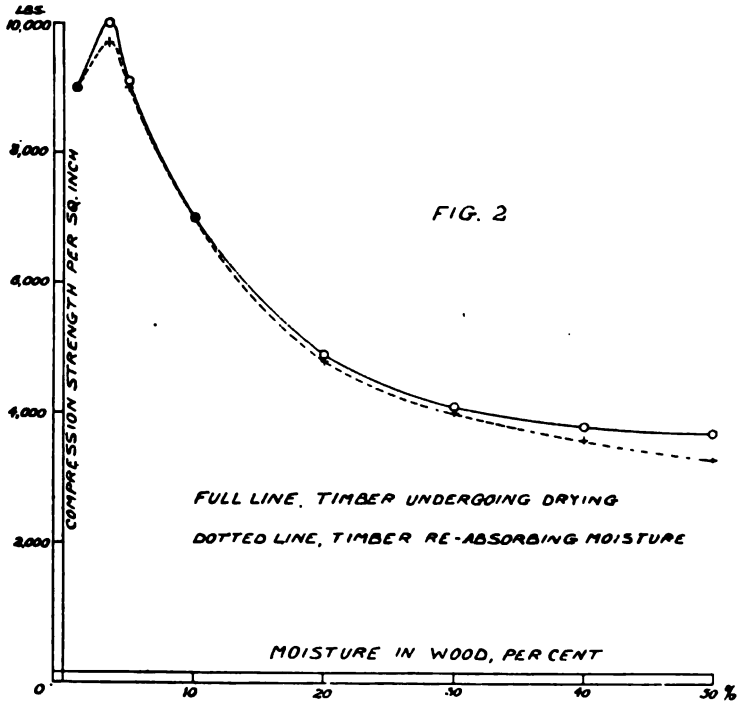
A reference again to Fig. 1, which shows this law of variation of strength with variation of moisture, brings out clearly the interesting fact that the maximum strength is not reached when the timber is perfectly dry, but when there is about 3 per cent. or 4 per cent. of moisture present in it. It is rather a difficult piece of experimental work, however, to determine this point very accurately, because, as I have already mentioned, when timber is dried below 10 per cent. of moisture, it tends to reabsorb moisture from the air extraordinarily rapidly.

In connection with this question of the influence of moisture upon the strength, the American experimenters investigated whether or not moisture reabsorbed into a specimen which had been dried had the same weakening effect as the original sap of the tree, and this was found to be the case.

The two curves in Fig. 2 represent (1) a series of tests with timber which was dried by gradually driving off the natural sap, and (2) a series of tests with very dry timber which was gradually allowed to reabsorb moisture, and you will notice that the two curves practically coincide. This is a matter of considerable practical importance in the case of timber used in underground situations, or in water itself, or in a water-logged

soil, where, unless special means are taken to prevent the absorption of water, the timber rapidly becomes very wet.

The American experimenters suggested a standard of dryness of 12 per cent. for comparing different sets of observations, and they found in their experiments that timber in such a condition of dryness was on an average about 75 per cent. stronger than timber which was quite "green," that is, filled with the natural sap.



Before leaving this question of the influence of sap or moisture on the strength of wood, I may mention that the American research dealt also with the effect of "bleeding," as it is called, or tapping the long-leaf (pitch) pine (*Pinus palustris*, Mill.) for its turpentine. It was commonly held that this process considerably weakened the timber, and also affected its durability. The investigation conducted by the Forest Department of the United States, with a very large number of tests, showed, fairly conclusively, that there was no marked effect produced by previous "bleeding" of the tree on the mechanical properties

of the timber, and similarly, apparently no effect upon these properties, or no marked effect, was produced by the modern system of rapid artificial seasoning of wood, as usually carried out by currents of hot air. Whether or not the durability may be affected is another matter, and that it was impossible to determine in an investigation of this nature.

Of the mechanical tests made upon specimens of timber, there are practically four of importance—tensile tests, compressive tests, cross-bending tests, and shearing tests. I will now deal briefly with each of these in order.

Tension Experiments.

Tension experiments are difficult to carry out, owing to the fact that, unless the specimens are prepared with very great care, it is almost impossible to ensure a pure tensile fracture. Most wood has little power to resist shear stress along the grain, or, in other words, the lateral adhesion of the longitudinal

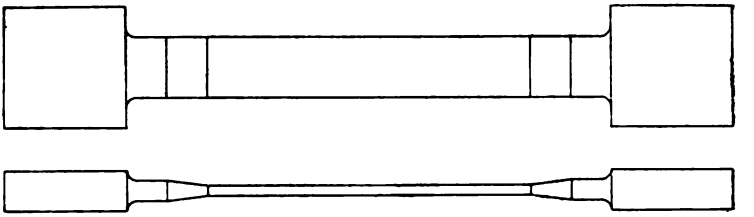


Fig. 3.

fibres to one another is very slight, hence shear very easily takes place along this line of weakness, and, therefore, unless the longitudinal fibres run perfectly truly through the specimen, which it is very difficult to ensure, a shear fracture very often occurs long before the real tensile strength of the material has been developed.

For the purpose of this lecture, I made a series of experiments on four different kinds of home-grown timber, viz., ash, beech, birch, and oak, and on hickory and mahogany, and the results that I have obtained are represented in the attached Tables.

One set of specimens was flat (see Fig. 3), carved so that in the centre the cross section was rectangular, 1½ inches wide and ¼ inch thick; the ends were left very much larger in section, and

were held by means of wedges in the dies of the testing machine. All the six specimens prepared in this manner broke fairly well in tension, except the fourth, the specimen of hickory; the results obtained are shown in Table I. Of course, I do not for a

TABLE I. *Tension Tests of Timber.*

FLAT BARS (Cross Section $\frac{1}{4}'' \times 1\frac{1}{2}''$).

Number of Specimen.	Kind of Wood.	Tensile Stress at Fracture.
		Tons per sq. in.
6796	Ash, . . .	4·08
6797	Beech, . . .	3·11
6798	Birch, . . .	10·14
6799	Hickory, . .	7·54
6800	Mahogany, . .	5·79
6801	Oak, . . .	4·97

moment wish to assert that the actual tensile stresses obtained in these few tests are a fair measure of the tensile strength of these different kinds of wood; my object, in these particular experiments, was more to bring out the extreme difficulty of carrying out satisfactorily tensile tests.

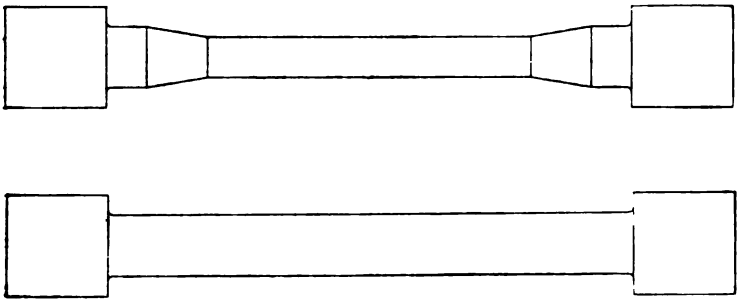


FIG. 4.

Two other sets of specimens were prepared, which were turned in the lathe into a cylindrical form (see Fig. 4), the ends being left enlarged, so that they could be held securely in the testing machine, and pulled from the shoulders thus formed.

One of these sets of round specimens was turned down to such a diameter in the centre as to give a tensile cross-sectional area of only about $\frac{3}{4}$ square inch, and the other set so as to have a very much larger cross-sectional area, of about $1\frac{3}{4}$ square inches. The first series of these round bars had ends so heavy and strong that, in order to shear the ends off, a shear area of $13\frac{1}{2}$ square inches had to be destroyed, while in the second series the ends were reduced in size so as to give only about 9 square inches of shear area. The results of these two sets of tests are given in Tables II. and III.

TABLE II. *Tension Tests of Timber.*

ROUND BARS (see Fig. 4).

Number of Specimen.	Kind of Wood.	Tensile Stress at Fracture.	Shear Stress at Fracture.	Method of Fracture.
		Tons per sq. in.	Tons per sq. in.	
6780	Ash, . .	6·62	0·37	Sheared at head.
6781	Beech, . .	6·93	...	Tension.
6782	Birch, . .	5·36	...	,,
6783	Hickory, . .	6·30	0·37	Sheared at head.
6784	Mahogany, .	4·19	0·25	,, ,,
6785	Oak, . .	2·95	...	Tension.

TABLE III. *Tension Tests of Timber.*

ROUND BARS (see Fig. 4).

Number of Specimen.	Kind of Wood.	Tensile Stress at Fracture.	Shear Stress at Fracture.	Method of Fracture.
		Tons per sq. in.	Tons per sq. in.	
6786	Ash, . .	2·22	0·45	Sheared at head.
6787	Beech, . .	2·37	0·50	,, ,,
6788	Birch, . .	2·39	0·43	,, ,,
6789	Hickory, . .	2·06	0·40	,, ,,
6790	Mahogany, .	0·76	0·15	Tension inside head.
6791	Oak, . .	1·92	0·40	Sheared at head.

You will observe that in the case of the first set, those with a small tensile area and a very large shear area, no less than three of them sheared at the head instead of breaking in fair tension, and you will notice how very low the shear strength per square inch is, as compared with the tensile strength, in these specimens. On the other hand, the tensile strength of those specimens which did give way in tension appears to be rather greater in the form of a flat specimen than in the form of a round specimen.

From Table III., which gives the results of the bigger round specimens, you will see that they practically all went by shearing at the head, though one would have been inclined to believe (in view of the fact that the shearing area was so large), had one not made the experiment, that there was abundant strength in the head to prevent any action of this kind taking place.

These few tests show then, first, that it is extremely difficult to get accurate and reliable tensile tests, and secondly, that in designing any part of a structure in which timber is subjected to a direct tension, the utmost care must be taken to see that it is strong enough in its various parts to resist the possible shear stresses which may be set up.

Other experimenters have found exactly the same difficulty. Professor Lanza, who made a series of tension tests on large specimens, stated that, in his opinion, tie bars in constructional work will always give way in some other manner than by direct tearing, for instance, by tearing out the fastenings, by shearing, and by splitting the timber.

Professor Johnson, in his research, meeting with the same difficulty, decided to abandon tensile tests, on the ground that timber would never fail in pure tension in practice.

Bauschinger, in his research, found that the elastic limit in tension practically was of the same value as the ultimate breaking strength, that is to say, that there is no marked limit of elasticity in timber when tested in tension; and he also found that the influence of the time of felling upon the strength in tension very soon disappeared.

I give in a Table some figures taken from Bauschinger's first research, in order to show the great difference between the strength in tension of the living sap-wood and the dead heart-wood. The figures in the Table represent the mean of eight tests

of the sap-wood and four tests of the heart-wood, and they include both summer-felled and winter-felled specimens.

Comparison of Strength of Heart-Wood and Sap-Wood in Tension, and of Summer and Winter Felling.

Tenacity in lbs. per square inch.

Kind of Wood.	Summer felled.		Winter felled.	
	Sap-Wood.	Heart-Wood.	Sap-Wood.	Heart-Wood.
Scots Pine, . . .	14,940	3,270	10,660	4,120
Norway Spruce, . .	13,790	4,413	17,630	4,905

Compression Tests.

It is a much easier matter to carry out crushing or compressive tests of timber, that is, it is much easier to make our specimens, and, as a rule, the results obtained are much more concordant among themselves. I shall deal here with only the more modern results, in which records have been kept of the moisture conditions at the time of the tests.

As a result of his investigation, Bauschinger was of opinion that when the point which it was desired to elucidate was the average quality of any given sample of timber, then compression tests were the best. For example, if it was desired to investigate for a particular kind of wood, say Scots pine, the influence of the time of felling upon the mechanical strength, then it could best be carried out by a series of compressive tests. Bauschinger's plan was to cut a disc out of each end, and from the centre of each log, then to slice these discs into four sections, and from each of these sections to trim out a square prism with its length about one and a half times its cross sectional dimension. Further, he decided that these specimens (twelve of them) should then be brought to a state of dryness such that the moisture was about 15 per cent., the density being determined by careful weighing and measurement. In his investigation into pine wood, Bauschinger found that the strength of short columns of this nature varied directly as the density of the wood.

I give below, in a Table, Bauschinger's results, reduced to a 10 per cent. dryness, for the same qualities of timber as those for which I have given the tensile results.

Summer felled.

Scots Pine, . . .	5310 lbs. per square inch.
Norway Spruce, . .	4770 „ „ „

Winter felled.

Scots Pine, . . .	7167 lbs. per square inch.
Norway Spruce, . .	5600 „ „ „

Professor Lanza made an exhaustive investigation into the strength of a large number of full-sized specimens of American timber, from 7 inches to 10 inches in diameter, and about 12 feet long; these all collapsed by pure compression, and the average results are given in the Table below:—

	Max.	Min.	Mean.	
Yellow Pine (*Pinus echinata*),	4720	3920	4370	lbs. per square inch.
Old and seasoned White Oak (*Quercus alba*),	5197	3965	4480	„ „ „

Professor Johnson, in the experiments for the American Forest Board, used compressive specimens 8 inches long and 4 inches square in cross section, these specimens being cut from the ends of other specimens, which had been used as beams.

For the purpose of this lecture, I tested a couple of specimens, one of beech and one of white (Weymouth) pine (*Pinus Strobus*). In all such tests there is a tendency to give way by shear, especially near one end, that is to say, the direct compressive force when resolved on a plane inclined to the axis of the specimen, produces a shear in this plane which soon exceeds the maximum shearing strength of the material, and thus a short strut in wood tends rather to give way by shear than by direct compression. The white (Weymouth) pine specimens only carried 2·31 tons per square inch of direct compression when shear set in.

Professor Johnson also agreed with Bauschinger that compression experiments were easier to carry out, and were the most valuable of all tests; he advised a factor of safety of 8 for dry timber and of 5 for green timber, when designing timber struts.

So far I have been considering merely compression applied endwise and with the grain, that is, compression upon the column of wood as it would ordinarily be used when built into a structure, but it frequently enough happens in actual practice that a piece of vertical timber stands or rests upon a horizontal piece, and transmits a crushing load to this horizontal piece, and the horizontal piece is, therefore, subjected to a crushing across the grain. Only comparatively few experiments have been made to determine what is the strength of wood under such conditions.

Tredgold many years ago found in his experiments that 1000 lbs. per square inch was sufficient, when applied in this way, to distinctly indent Memel fir, while about 1400 lbs. per square inch was required in the case of good English oak.

Of course it is very much a matter of judgment as to what constitutes the limiting crushing load in such a case, that is, what amount of indentation shall be considered to be the limit which can be allowed. Some authorities give $\frac{1}{20}$th inch in depth of indentation. Professor Johnson took 3 per cent. compression as a working limit, which would amount to an indentation of $\frac{3}{8}$ inch in a beam 1 foot thick, and 15 per cent. as a destructive indentation, which would amount to about $1\frac{3}{4}$ inches in a 12-inch bar. He experimented with specimens 2 inches and 4 inches thick, and he found in the case of pines or soft woods that the compressive strength, when dealing with this cross grain compression, was only about one-fifth of that which could be developed when the compression was applied along the grain, and in the case of American oak it was about one-third.

I made a couple of tests for this lecture; for the white (Weymouth) pine I found a compressive strength across the grain of only 0·79 ton, as compared with 2·31 tons when tested in direct compression along the grain, that is, the strength was about one-third, and this, too, when the direct compression strut was a fairly long one.

I have said enough to indicate the importance of considering this matter of strength across the grain when designing structures in which timber is used in this way.

Cross-Bending Tests.

Tests of timber beams are a very favourite method of determining the mechanical properties of any specimen of timber, partly because large pieces can be used, and the loads are not excessive,

if the span is a big one, and secondly, because it is a kind of test which can be carried out quite readily on the works, with a fair degree of accuracy, without any elaborate apparatus. Two knife-edges, or supports, for the ends of the beam, a cradle to sling from the centre, in which pig-iron or any other convenient kind of heavy weight can be placed, a stretched cord, and a 2-foot rule, are practically all that is needed to give fairly good tests when this description of stress and strain is adopted.

I give again in a Table some of Bauschinger's results, made on beams 7½ inches by 7½ inches, with a span of 98 inches.

Kind of Wood.	Modulus of Elasticity.	Limits of Elasticity.	Breaking Stress.	Density.	Moisture per cent.
Scots Pine—	lbs. sq. in.	lbs. sq. in.	lbs. sq. in.		
Summer, . . .	1,535,000	2,867	6,720	0·50	23
Winter, . . .	1,465,000	3,136	6,405	0·55	33
Norway Spruce—					
Summer, . . .	1,563,000	3,247	5,957	0·45	29
Winter, . . .	1,650,000	3,719	6,406	0·45	27

It is desirable that I should point out at once that the calculated stresses produced in the outer fibres of a beam when it is subjected to cross bending, as determined by the ordinary formula employed for that purpose, are only reliable, and only represent the real condition of affairs when the stress does not exceed the elastic limit, because beyond that elastic limit the assumptions upon which the ordinary beam formulæ are based do not in the least apply; hence the figures given in the above Table, under the heading "Breaking stress in lbs. per square inch," are not really actual stresses at that instant, but they are figures useful enough for comparison purposes.

In the following Table, results are given which were obtained by Professor Lanza in a number of experiments on American timbers, and in this case I have given the maximum, minimum, and mean results obtained for each quality of timber, in order to show the very great variation there is in the strength of timber of apparently the same quality.

Cross Breaking Stress per square inch, in lbs.

Kind of Wood.	Maximum.	Minimum.	Mean.	Mean Modulus of Elasticity.
Spruce, ... (*Picea alba*).	8,756	2,994	4,883	1,330,000
Yellow Pine, ... (*Pinus echinata*).	11,360	3,962	7,289	1,744,000
Oak, ... (*Quercus alba*).	7,660	4,985	6,074	1,292,000
White Pine, ... (*Pinus Strobus*).	7,250	3,437	4,807	1,080,000

Professor Johnson's experiments upon cross bending for the Forest Department research were made upon beams 4 inches square, and tested upon a 6 foot span; and, in his investigation, great care was taken to arrange the load in such a way that it increased gradually, and increased the deflection gradually, at a rate of about $\frac{1}{8}$ inch per minute, until the final rupture point.

There is no doubt whatever that different results can be obtained in cross-bending tests of timber by varying the rate at which the load is applied. This is a fact well known, of course, to all experimenters, and is true not only of timber, but of all other materials.

The next Table gives the results obtained by Professor Johnson, and I have collected into this Table not only the cross-bending stresses, but the crushing strength, both endwise and across the grain, and also the shearing strength of the timber.

Kind of Wood.	Sp. gr.	Weight per cubic foot.	Cross Breaking Stress per square inch. Lbs.			Crushing Stress per sq. in. Lbs.		Shear Stress in lbs. per sq. inch.
			Limit of Elasticity.	Final Load.	Modulus of Elasticity.	End-wise.	Across.	
		lbs.						
Long-leaf Pine, . (*Pinus palustris*).	0·61	38	10,000	12,600	2,070,000	8,000	1,260	835
Red Pine, . . (*Pinus resinosa*).	0·50	31	7,700	9,100	1,620,000	6,700	1,000	500
White Oak, . . (*Quercus alba*).	0·80	50	9,600	13,100	2,090,000	8,500	2,200	1,000
White Elm, . . (*Ulmus americana*).	0·54	34	7,300	10,300	1,540,000	6,500	1,200	800

All these results have been reduced to 12 per cent. moisture conditions.

In order to give some idea of the great variation in the strength of timber, I may say that in these tests, out of one hundred samples of the same kind of timber, 54 per cent. of

them gave results within 10 per cent. of the mean, while 96 per cent. of them came within 25 per cent. of the mean.

It is well to state here that in all these researches with which I have been dealing, only absolutely bad stuff was rejected for testing; no attempt was made to pick specially good specimens.

One important result brought out in Bauschinger's research, and confirmed in that of Johnson, was that the mechanical strength of timber is considerably affected by the ratio of the summer, or solid, growth to the spring, or open, growth in each annual ring; or, in other words, that the density or specific gravity is a very important factor. It was also proved, in this investigation, that there was a definite relation between the modulus of elasticity, as determined in the bending tests, and the crushing strength and bending strength, as determined in tests of the same timber.

Shear Tests.

In testing timber beams, I frequently find that the beam gives way, not by tearing across, but by shearing along the neutral axis, and other experimenters have found exactly the same condition of things.

For example, in Professor Lanza's tests of beams, no less than eleven gave way in this fashion, the shear stress at the time when the rupture took place along the neutral plane being, in the case of spruce, only 191 lbs. per square inch, and in the case of yellow pine, 248 lbs. per square inch, and, by calculation, he showed that this was also about the intensity of the shearing stress, in a vertical plane, in the case of those beams which did give way by actually tearing across. There has not been a very large number of direct shearing tests.

The round tensile specimens which I prepared for this lecture, with intentionally small heads, act very satisfactorily as shear specimens, and the results given in Tables II. and III. give very accurately the shear strength of these different kinds of wood.

In the Watertown experiments, the results obtained in direct shear tests were somewhat higher than those in the case of the beams which gave way by shear; this effect is due largely to the following cause—in a special shear test one fixes, by the form of the specimen, the particular plane at which shear shall take place; on the other hand, in the case of the beam, the shear takes place along the plane weakest to resist shear near to the neutral axis, and therefore one gets a lower shear strength.

II. *Concerning Natural Regeneration in general, together with Special Details regarding a typical example of Natural Regeneration of the Scots Pine at Beauly, Inverness-shire* (with Photographs). By GILBERT BROWN, Beaufort Cottage, Kiltarlity, Inverness-shire.

In natural forests a process is continually going on which ensures their perpetuation from one generation to another; and "natural regeneration" is the formation of a new wood by the natural fall of seed from the mother-trees, which germinates and develops into a crop of seedlings. This term distinguishes such a process from "artificial sowing or planting" in the nursery or forest, otherwise the methods involved are as natural in the one as in the other.

In forests of vast extent, in which regeneration has taken place, the preponderance of a very few species is usually a characteristic feature, and the nature of the climate and the composition of the soil determine in great measure what this species shall be. Throughout America and parts of the Continent of Europe, pure coniferous forests are often found resulting from natural regeneration, because, when any particular tree is specially favoured by the soil, situation, or climate, it propagates itself readily, to the more or less complete exclusion of others. Thus, on a fine, deep soil several different species may be found growing side by side, while on rocky, bare ground only a few hardy trees, endowed with special qualities, are to be found, and on a swamp, alder or poplar. These are extreme examples, but the more similar the nature of the trees, the keener and the more prolonged will be the struggle, though the result will ultimately be the same. This may also occur in woods under careful management, owing to such reasons as a desire for uniformity of appearance, or for the easy management of the woods, because, wherever a system in any way favours one kind of tree, it is placed in a more advantageous position than other kinds, with the ultimate result that these latter become greatly diminished in number.

When it is desired to restock a wood with young seedlings after the old crop has reached maturity, three conditions are essential, viz.—(1) *Presence of seed-bearing trees;* (2) *soil suitable for the germination of the seed and the growth of the plant;* (3) *timely removal of the old trees.*

1. Presence of Seed-bearing Trees.

In order to eliminate the chances of failure, and to benefit the production of seed, the crowns of the old trees ought to be well exposed to sunlight, so as to stimulate the production of flowers and fruit. When coniferous trees are crowded together, the cones are invariably small, and the germinative power of the seed is weak. Therefore a few of the most vigorous trees, or at least such a number as may be necessary, should be carefully isolated a few years before the main crop is cut. When thinning is required, the first aim is to remove all such trees as are not desired to reproduce themselves, such as birch, which springs up like a weed whenever an opening occurs, and which, if left alone, will overrun the ground and check other species. Partly suppressed trees are next removed, and those with wide-spreading crowns occupying an unduly large growing-space. The extent to which a wood should be thinned when approaching maturity depends, of course, on the density of the crop, and while the thick parts may perhaps have to be thinned freely, the thin parts may sometimes remain almost untouched, or possibly the whole may be left until seed-production.

2. Soil Suitable for the Germination of the Seed and the Growth of the Plant.

The average Scottish woods, being usually rather thinly stocked, are often more or less over-grown with weeds, such as rough heather, bramble, bracken, bilberry, and thick masses of wire-grass and moss. The first three are not generally difficult to dispose of. *Heather*, when very dry, can be destroyed by burning against the wind, so as to keep the fire partly in check and to burn closely. After burning, however, the soil is seldom in a fit state to receive seed, and soil-preparation has to be resorted to, as will be dealt with later on. *Brambles* can be cut or grubbed up, the latter being by far the preferable method, as it also serves to loosen the soil and make it more suitable as a seed-bed. The heads of *bracken* are easily nipped off when they begin to form; and, generally, wherever bracken is growing, low weeds are kept so much in check that the mineral soil is usually to be seen, which forms a good seed-bed. The other weeds are not so easy to cope with. Where *bilberry* exists in masses, natural regeneration is well-nigh impossible, as it forms such a

thick net-work of roots that no seed gets near the mineral soil. The bilberry also exhausts and dries the surface-soil so much, that very few seeds can germinate owing to the dry, dead nature of the ground. In planting it is quite useless to put in plants with the T-notch unless the bilberry is first cut away, and the roots and dead surface removed; and if this is imperative before artificially-inserted plants can thrive successfully, neglect of it gives little hope for successful natural regeneration. Where a combination of *wire-grass and moss* exists, the case is equally difficult. In woods with such a soil-covering, it is a difficult matter to determine how to clear the ground. Tearing up the moss in strips yields fair results, but is expensive; burning, when very dry, reduces the moss to a slight degree, but generally leaves a layer of moss and grass-roots which no radicle can push through, and in such cases it is useless to trust to natural regeneration.

The rational method of treating woods is to keep the trees in close canopy throughout the entire life-period of the crop, so that the shade prevents the growth of surface-weeds. To keep a wood in such a manner is difficult, because, generally, as a wood grows older it gets more open, and especially if formed of light-demanding trees without any shade-bearer having been introduced to help to maintain close canopy, and thus protect the soil. In plantations of hardwoods (and especially of beech) with a dense leaf-canopy, the fallen foliage and other débris usually accumulate at a more rapid rate than decomposition proceeds, with the result that a mass of leaves and dead branches (*raw humus*) covers the ground. When such is the case, the seed is not likely to germinate to any great extent, and the ultimate result is that the seedlings damp off in a few weeks. This is easily remedied by raking the leaves together when dry, and burning them, nothing else being required to make the mould below a good seed-bed. But though the supply of seed may be abundant, and its quality good, the seedlings have little chance of establishing themselves unless the surface is comparatively free from weeds and rubbish, and is in a loose friable condition.

3. Removal of Seed-bearing Trees.

The proper time for the removal of seed-bearing trees depends mainly on the light or shade required by the young seedlings. Some kinds of young growth are more liable to be injured by

late frosts than others; and although old trees do not prevent this altogether, yet the shelter afforded by the crowns lessens the danger considerably. Again, if the parent trees are allowed to stand too long, they have a deteriorating effect on the young seedlings, by checking their growth or causing them to grow up weak and crooked.

On ground stocked with light-demanding species, the old trees, and especially oak, may be dispensed with early.

The removal and cutting of old standards on a regenerated area is always a matter of difficulty, as a certain amount of damage cannot be avoided. But if the trees have been carefully selected, and only those with narrow crowns left, the damage is not so serious as one would expect. Young trees quickly replace a broken leader, and if the crop is thick a few are never missed. In removing the trees, it is a wise policy only to use a janker, as the logs can then be lifted and taken out easily with little damage, because the tramping and moving about of men and horses necessary for loading on an ordinary cart often causes more damage than the fall of the trees.

As regards coniferous woods, the two principal factors which determine the success or failure of natural regeneration are the surface-weeds, and the annual fall of dead needles. As to the former, much depends on the leaf-canopy. Shade-bearing, heavily-foliaged trees, such as spruce or silver fir, check undergrowth much more effectually than the majority of pines, which allow more light to penetrate through their crowns. But a great deal also depends on the density of the crop. As the majority of Scots pine-woods are too open, undergrowth of a varied character is then always to be found. Open woods are undoubtedly more pleasing to the eye than close canopy with comparatively bare poles; and the prospect of a quick return from early thinnings may induce over-thinning, present requirements being considered before future advantages.

In over-thinned woods the thick undergrowth not only retards the germination of seed, but also uses up a great deal of plant-food otherwise available for the growth of the crop. In woods covered with weeds, seedlings may often be found wherever the mineral soil has been laid bare, *e.g.*, as where wood has been dragged. Hardwood seedlings, being stronger and more robust than those of conifers, are able to push their radicle through the roots of the grass to the soil beneath; but seedlings of conifers

are less successful in doing this, and therefore soon die for want of sustenance. And as the seeds of most hardwoods are heavier than those of conifers, this also gives them a better chance of getting into contact with the soil.

A light soil-covering of *heather* is not altogether a drawback, as it affords some shelter to young seedlings; but in sheltered positions good moss often grows thickly about its roots, and intercepts the seed as it falls, while seeds which may happen to germinate soon damp off, as they do on a grassy surface.

Before attempting natural regeneration, therefore, it is important that the ground should be fairly clear of weeds, though their subjugation is often impossible. Where heather abounds along with moss, burning has on certain kinds of soil the drawback that it leaves a hard surface, owing to the fire eating into the fibrous layer. The weeds ought therefore to be burned before the trees are felled, for in quick burning no harm is done to the standing trees, while dragging and removing the felled timber break up the crust thus formed, and allow the seed to fall at once on loose soil.

In many Scots pine-woods the lack of young seedlings is often attributed to the shade of the old trees, but this is not the sole cause. Around Scots pine-trees there is invariably a mass of needles, the decomposition of which is assisted by saprophytic fungi (chiefly *Botrytis cinerea*, the common grape-mould), whose mycelium permeates the layer of fallen needles; and as seedlings germinate there, they push their tender radicle into this fungous mass and are killed. That this damping off is due to fungous infection, and not to atmospheric conditions, is probable from the fact that when part of the dead leaves has been removed, artificially or otherwise, young seedlings spring up and thrive on these disturbed parts, if not checked by other agencies; whereas, on the adjoining parts where the leaves are lying, plants are either entirely wanting, or are exceptionally rare of any large size. It may be that the lack of nourishment in this layer leads to the damping off of young seedlings, but it is certain that on ground covered with a close mass of weeds or leaves one cannot trust to natural regeneration without artificial assistance.

In the unassisted natural regeneration of Scots pine-woods, the process is, of course, one of natural selection. Nature's method, however, is not the selection of trees to be *taken out*,

but the selection of trees *to remain* as seed-bearers, owing to their superiority over the other trees that have been growing around them. A process which includes the gradual decay, as well as the gradual growth, of every tree in the forest must be subject to a very radical alteration when felling (*i.e.*, artificial selection) takes the place of decay in effecting natural regeneration. Such alteration consists in an artificial process of destruction by felling. There are different methods of effecting this, but those which appear to be most suitable to Scots pine are the "Selection" and "Strip" systems. In the former, from 12 to 15 trees per acre are selected for seed-production. They ought to be distributed over the area in such a manner that some should stand as near to the windward edge as possible, so that every advantage may be gained in spreading the seed. Such seed-producing standard trees should be selected before the final felling, and should be healthy trees with crowns of medium breadth. It may happen, however, that from such trees having been partly sheltered while the whole crop was standing, the root-system is so weak as to make them liable to be blown down if exposed, hence it is wise to leave a good shelter-belt to windward, or to select more than the 12 to 15 standards to the acre needed for seed-production.

In the second or "Strip" system, however, the regenerative process is not conducted uniformly over the whole area, but the wood is divided into strips, which are then taken in hand one by one, and thinned out so as to prepare the trees for seed-production. As soon as one strip is naturally regenerated, the adjoining strip is cut out, and the next two thinned; and so on, until the whole area is regenerated. This method is satisfactory in forests of large extent, and where a long strip can be cut, so that a large lot of trees can be sold at once, for a big fall always commands a higher price than a small lot. In regard to the width of the strips, no fixed rule can be laid down; they ought not, however, to be too wide.

The best examples of natural regeneration of Scots pine are perhaps to be found in the north of Scotland. Balblair Wood, Beauly, forms a very typical and successful example, so far as it produced an excellent crop of young plants. The "Selection" system was adopted throughout, no definite rotation being observed, but trees being felled when required, until the

final cutting. The number of acres naturally regenerated is about 130. This is practically divided into two different compartments, the first (104 acres) having trees of about 45 years of age, and the second (26 acres) having trees of about 35 years of age, with old standards.

The photographs at the end of this article show the trees in these two compartments. No. 1 shows trees of 45 years of age, and Nos. 2 and 3 the younger crop, 35 years of age, taken at different points, while Nos. 4 and 5 show the position the old standards occupy amongst the young crop (No. 4 showing principally the head of an old standard, and No. 5 the bole).

In the older compartment felling occurred about fifty years ago, and standards with straight boles and narrow-shaped crowns were left to the number of about 30 to the acre. Owing to the surface of the ground being greatly broken up by men, horses, and carts during the removal of the timber, and to the soil being friable and only slightly covered with moss, young plants came up very soon after the fall. These conditions favouring natural regeneration in this case, the young crop came up so thick that it had to be thinned early; and it was undoubtedly a little over-thinned up to about 30 years of age, as at the present time the crop, now about 45 years old, only consists of from 390 to 430 trees per acre. This leaves very few to come out in case of accidents, such as wind-blows or deaths by natural causes, and unless now treated carefully the final crop will be small. The trees throughout have grown well, and are well developed and clear of branches to about 20 feet; but as the subsoil is of a hard nature, the growth of the trees is now very slow, and they are throwing out large side-branches.

The second and younger compartment forms something like a two-storied crop, being composed of old standards and poles of about 35 years of age. This part was also cut over preparatory to natural regeneration, selected standards to the number of about 30 trees to the acre being left as seed-trees, which yielded a heavy crop of seed almost at once. Photograph No. 4 shows that the old standards were growing openly, as the side-branches can be seen mixing with the crowns of the trees forming the young crop. The boles are short, but large in cubic contents, which shows that the trees have had

a free-growing space at an early age. The surface being only lightly covered with moss, through which the mineral soil could be seen, and the soil itself being loose, young seedlings at once sprang up so numerously that they had even to be freely cut out in bunches when about seven years old, leaving plants about 3 feet apart. The plantation remained untouched till about twelve to fifteen years old, when light props were taken out, leaving the poles standing from about 5 to 6 feet apart. A few of the double-headed and backgoing poles have been thinned out since, leaving about 1000 trees per acre. Owing to a hard substratum, they have not grown so rapidly as during the first fifteen years; but they form a nice crop of clean well-formed poles.

The system of leaving the old standards until the leading-shoots and branches are in touch with the lateral branches (as in this case) is one that cannot be recommended, as a certain number of the young crop must inevitably be sacrificed, unless an extra amount of trouble be bestowed on the felling. Had the old trees been cut out when the young growth was a few years old, the few of the latter that would have been destroyed could have been cut out without any damage to the crop.

Although the methods adopted in the above two cases were far from being perfect, yet the results show an exceptionally fine young crop, which required no artificial assistance in the way of filling up gaps.

[It will afford the *Transactions* Committee much pleasure if foresters kindly favour them with practical details such as those contained in the last two pages.—HON. ED.]

No. 4.

No. 5.

III. *The Prospects of growing Timber for Profit in the United Kingdom.* By ARCHIBALD E. MOERAN, Land Agent, Palmerston House, Portumna, Co. Galway.

The subject about to be discussed can be considered from two points of view—(1) What are the prospects that timber can be grown in the United Kingdom at a profit? and (2) What may such profits, if any, be expected to amount to?

A difficulty presents itself at the outset. We have evidently to deal more with future operations than with past results. I think it may be taken for granted that future work in the United Kingdom will be much more influenced by Continental lessons than has been the case in the past, and that the hope of profit lies in the skilful adaptation of Continental methods to our home conditions. The natural course to take, therefore, is to describe the French and German methods of management, to quote from the accurately kept statistics of their Forestry Departments, and to argue from analogy that our woods should, and could, yield like results if treated similarly.

Here, however, we are to confine ourselves to British data, although these foreign yield-tables are, after all, the most solid facts we possess upon which to base our calculations. And though to leave them out makes the subject more difficult to handle, it certainly makes it more interesting; and it covers ground which has been but lightly passed over by most writers.

In any business enterprise dealing with the production of a marketable material, there are three factors which govern the amount of profit that can be made, and all efforts towards increased profits must deal with one or other of these, namely,—(1) *Cost of production;* (2) *amount of material produced;* and (3) *marketable value of this material.*

Any improvement that can be accomplished in one or other of these factors must result in increased financial returns, presuming, of course, that the other two remain constant. Progress may be possible in two, or in all three issues at the same time, and would then prove all the more remunerative. Now, the growing of timber for profit is essentially a business enterprise, which will prove successful in proportion as it is in the hands of men who are not only skilled in their profession, but are also keen men of business; and any lack of ability or inattention to detail on the

part of the management will be followed by the results which attend such faults in the commercial world.

Let us therefore, very briefly, take each of these factors in turn, and see what possibilities of improvement there may be in the future.

1. Cost of Production.

It seems probable that we shall have to face a somewhat increased rate of wages in rural districts in the near future. Where cleared areas are being replanted, as a rule there is neither fencing nor draining to be done, and the labour-bill is only for the actual planting of the trees. When much labour is necessary in draining or reclaiming, any addition to the rate of wages may become serious. However, the fact that such work can be done during winter, when other work is slackest, will usually secure a sufficient number of men at reasonable wages. The chief way in which we may expect to reduce the cost of production is in more methodical expenditure, that is to say, in avoiding the expense of all unproductive work; and we must look to an improved knowledge of forestry, in its widest sense, to aid us in this. Theoretically, every item of expenditure should yield its share of profit; but we all know of numbers of cases in which money has been freely expended on work never likely to prove profitable. It is this "knowledge before the event" which we must hope to see more general.

The cost of plants of the commoner kinds of forest trees may be counted on as remaining much on the average of the last ten years, but there can be no doubt whatever that the prices of what are called "the rarer conifers" will, within the next few years, be reduced to about the price of larch. The large nursery-firms on the Continent have recognised that such kinds as *Pseudotsuga Douglasii*, *Picea sitchensis*, *Tsuga Mertensiana*, *Thuya gigantea*, and *Pinus Strobus* are trees which are to be planted by the thousands and by the tens of thousands; and they are at present offering them at prices not greatly in excess of quotations for larch. Given a sufficient demand, our home nurserymen will have no difficulty in also supplying any of the[se] at prices which will admit of planting them on a large scale.

The saving that can be effected by planting large areas is not generally appreciated. In the fencing this is very marked; because,

if	1 acre	costs	£8	0	0	to fence,	
then	4 acres	will cost	£4	0	0	per acre,[1]	
	16 „	„	£2	0	0	„	
	64 „	„	£1	0	0	„	
	1024 „	„	£0	5	0	„	

All economies are more easily carried out on large areas than on small ones, and the results are also more marked. Better men can be employed, and a good system is more feasible. Good roads can be constructed or tram-lines laid down, enhancing the price of the produce, with many other things which smaller areas would not warrant, but which tend (though perhaps indirectly) to cheapen the cost of production.

2. Amount of Material Produced.

We have, I think, every reason to feel confident that it is possible to make good progress in this direction. Without going into the history of British forestry, it is enough to say that it is now generally admitted that our foresters were, up to very recent years, taught to over-thin woods at all stages of their growth, but especially during the first thirty years, to an extent that has caused great loss, not only to the owners of the woods upon which they operated, but to the cause of sylviculture generally. Little distinction was made in the treatment of shade-bearers, such as beech, silver fir, and spruce, and light-demanding trees, such as larch. The fact that a certain kind of tree was a strong shade-bearer, was looked upon as a drawback, as it would not clear its lower branches satisfactorily in the open woods of carefully-spaced standards, which were looked upon as the *sine qua non* of correct forestry. It does not seem to have occurred to these men, clever foresters though they were, that shade-bearing attributes are one of the highest qualifications a tree can possess, as the stronger its powers are in this respect, the heavier is the crop that can be produced per acre. Furthermore, when the object aimed at is the production of the greatest quantity of saleable timber, this attribute is of two-fold value, as, to secure long, clean timber, a thick crop must be grown (there is no other way of cleaning the stems), and, conversely, if you aim at the heaviest obtainable crop, you

[1] This presumes, of course, that all such different areas fenced are in squares, or in similarly-shaped rectangles. in each case.—Hon. Ed.

are bound also to have clean, marketable timber; and these things are only now beginning to be understood and acted on by foresters.

I knew a pure spruce wood about 55 years old, skirting a public road, in which the trees stood about 420 to the acre. Local popular opinion pronounced this so thick that the wood was considered ruined beyond hope, and was regarded as the sylvicultural scandal of the neighbourhood. Even the owner spoke in apologetic terms of this blot upon his estate, yet, as a matter of fact, the highest British forestry authorities will now say that 450 spruce to the acre at 55 years is a very thin crop indeed, except on land of exceptionally good quality for spruce. Unfortunately, this wood was entirely blown down in the storm of February 1903, and a timber merchant has a saw-mill now in the middle of the débris. The timber is cutting out very clean, and he is not at all inclined to criticise the owner harshly for his neglect of thinning.

I am dealing at present altogether with shade-bearing kinds of trees, for reasons which I will give later; and with such the amount of yield per acre, and the quality of the yield, bear so strongly upon each other, that it is difficult to separate the subjects. I shall therefore include the third factor in the question of profit.

3. Marketable Value of the Produce.

When dealing with the prices of young trees, I mentioned some of the rarer conifers. In my opinion, some of these species are destined to play a part in British forestry that is not yet at all realised. The quality of the timber they produce in their native woods is known. It is the best timber from the most wonderful timber-producing region in the world. That they will produce a heavy yield per acre, no one who has travelled through those regions will deny. After a forest fire the seedlings come up almost as close as heather over the charred ground. The common mixture in some of the finest timber districts is red fir (*Pseudotsuga Douglasii*), western hemlock (*Tsuga Mertensiana*), and red cedar (*Thuya gigantea*). On the burned area the young red fir takes the lead and keeps it. It will stand plenty of side-crushing, but requires overhead light and a free head. For the first 80 years it will average quite 2 feet growth in height per annum; and at 80 years the average circumference is from

4 to 5 feet at breast-height. In rate of growth, as to both height and girth, the hemlock and cedar are left behind, but they are patient shade-bearers, and creep steadily up, forming perhaps the densest forests in the world. If a red fir dies, or is cut or blown down, the increase of light brings up the waiting hemlock or cedar, like a soldier stepping into the place of a fallen comrade, so that the overhead roof remains unbroken. Several big lumber companies are now going back on land which was cut over or burned fifty or sixty years ago, and are cutting therefrom marketable natural second-growth timber. This seems an encouragement to us who have to begin at the beginning. While the admittedly splendid timber from these regions was being cut from giants 300 to 400 and 500 years old, it required some courage to advocate planting these species on our own hill-sides. Now, however, with the knowledge we are collecting of the timber as actually produced in Great Britain and Ireland, our confidence should increase.

I have described these trees in their far-off home for a purpose. We have brought them from a climate very similar to our own,[1] with a rainfall of 50 to 70 inches brought up by the wet west winds from the Pacific. They have proved that they grow and thrive under favourable circumstances in this country, and there is every reason to believe that they will produce good timber *if they are grown under suitable conditions;* and this is what I want to emphasise. Already there has been a great deal of money wasted in planting these kinds of trees under conditions which have produced handsome trees, but poor in quality as timber. The United States Bureau of Forestry has carried out exhaustive tests with most of the native-grown timbers. It reports that, after testing a great number of specimens of red fir, or Oregon pine, ranging from 28 to 4 annual rings to the inch, it has been found that about 20 rings to the inch gives the best results; that from 12 to 15 rings to the inch may be called timber of good quality, suitable for ordinary building requirements, but that the quality of the timber deteriorates in direct proportion as the rings gets wider; and, further, that all the timber with 7 rings or less to the inch has been found to be blemished with knots, which to a certain extent impair its

[1] Is such actually the case? Is not the summer-warmth much greater there? And is not the intensity of the sunlight there also much greater throughout the annual period of vegetation?—HON. ED.

strength. We have, unfortunately, no Forestry Department of our own where tests might be carried out with home-grown specimens,[1] but these figures of the U.S. Bureau of Forestry furnish evidence that, so far as regards rate of growth in girth, we ought to be able to grow these kinds of trees so as to produce timber of first-rate quality.

SUMMARY.

The reason why I have taken this group of shade-bearers and dealt almost entirely with them is that it is quite too large a subject to discuss in detail for each kind of tree and for each mixture by itself. Looking at the question broadly, I eliminated the hardwood trees, not because they cannot be grown at a profit (as I am aware that on occasions they have proved most remunerative), but because, as a rule, they must be grown on land of fairly good quality. They are not generally suitable for planting on waste land of any description. They are usually planted in the interior of landed estates, and here they are subject to so many outside influences (for the purpose of game, ornament, or shelter) that they cannot be, and as a matter of fact are not, looked upon as plantations made for profit.

I was left, therefore, to deal with the coniferous trees on land of medium to poor quality. Much of this is suitable for larch, but I need not go into the reasons why extensive larch plantations have become a hazardous class of speculation. In any case, what we want is to produce timber that will supply in part the enormous demand for building and joinery purposes. The price of larch is kept up by the great quantities used in the collieries. It is quite conceivable that within the next fifty years some substitute may be found for this, and in such case the price of larch would probably fall considerably.[2] The demand for timber for constructive and general indoor

[1] An article by Professor T. Hudson Beare on "Timber: Its Strength, and How to Test It," in which some home-grown timbers are dealt with, occurs at page 1 of this volume of the *Transactions*.—HON. ED.

[2] With creosoting, naphthalining, and saccharising at 3d. to 4d. per cubic foot, softwoods of all sorts that readily take antiseptics become more durable (so far as the action of damp and warmth, fungi, insects, etc., are concerned —apart from the action of strains and other mechanical effects) than the best larch or oak. This fact is bound to produce its natural economic results wherever planting for profit is being considered henceforth.—HON. ED.

work must always continue, and there is every probability that the price of this class of wood will continue to rise steadily, as it has been doing in the last ten years, owing to the gradual shortage of supply and the increased demand in other countries as well as our own. As regards our older conifers, Norway spruce, silver fir, and Scots pine, I must admit that I am not a great believer in the common or Norway spruce (*Picea excelsa*). It does not yield timber of first-rate quality, and there is no reason why we should blindly stick to it if we can find other trees which promise better results. Silver fir I believe to be a more profitable tree than Norway spruce; but it will not succeed on many kinds of soil, and its timber is, at the best, not of sufficiently good quality to warrant its general use. With regard to Scots pine, I do not wish to depreciate the good qualities of this tree, which will probably always continue to be the backbone of all planting operations on land of poor quality. Its good qualities are too well known to require enumeration, but, at the same time, it has a great proportion of sap-wood, worthless for all except the cheapest purposes, which it carries up to at any rate eighty years of age.[1] Another drawback, and a very serious one, is that after about fifty years pure Scots pine opens out overhead, and thereafter fails to protect the soil. That is to say, it is not, during the latter part of its life-period, a good shade-bearer. Looking at the whole situation broadly, therefore, it seems to me that if we can procure a class of trees suitable to different elevations, soils, etc., and capable of being grown satisfactorily in mixed woods formed for purposes of experiment, then no one will deny that the introduction of such trees on an extensive scale into Great Britain and Ireland would hold out a fair promise for the profitable growing of timber in this country; and the timber-producing districts of Western Washington and Oregon in the United States, and of British Columbia in Canada, seem those most likely to supply the class of trees we require.

[1] Creosoting, naphthalining, and saccharising have entirely altered this, because the soft sap-wood is that part which absorbs the antiseptic substances most readily and in largest quantity.—HON. ED.

IV. *The Laying-out of a Mixed Plantation, and its Maintenance for the first Twenty-five Years.* By DONALD M. MACDONALD, Assistant Forester, Alnwick Castle, Northumberland.

The reasons for mixing different kinds of trees in woods are that this secures—

1. Protection against fungi, insects, etc.
2. Introduces trees which are perhaps more valuable as thinnings than the principal species.
3. Reduces the cost of planting by using cheap trees, which act as nurses to the more expensive ones forming the bulk of the plantation.
4. If one species fails, another is there to take its place.
5. The condition of the soil is improved by interplanting heavy-foliaged trees along with thin-foliaged ones.

Against the above advantages, reasons might be given in favour of growing woods pure; but, with several classes of trees, mixed planting is the proper course to adopt in starting them. I shall therefore consider the subject from the following points of view:—

1. *Formation of Mixed Woods.*—(1) Fencing; (2) draining; (3) cleaning the ground; (4) laying out roads and rides; (5) treatment of the plants in the nursery; (6) planting; (7) kinds of trees suitable for mixing; (8) system of mixing; (9) shelter-belts.

2. *Maintenance for Twenty-five Years after Planting.*—(1) Beating-up and cleaning; (2) protection against game, vermin, and fungous diseases; (3) thinning.

I. FORMATION.

1. *Fencing.*—The first step to be taken in the formation of any plantation is to erect suitable fences to protect the trees against the inroads of sheep, cattle, and vermin.

(a) *Fences against Sheep and Cattle.*—There are many different styles of erecting post-and-wire fences, but the most effective and cheapest in the long run is one consisting of either creosoted pine-wood, larch, or oak straining-posts 7 ft. 6 ins. × 6 ins. × 6 ins.

sunk about 3 ft. 9 ins. into the ground, with a sole dogged on to the ends, and with winding-brackets on each side every 100 yards or so, if the fence runs in a straight line. When the fence takes a bend or dip into a hollow, it is necessary to have intermediate straining-posts well stayed back on the inside. The posts should be about 6 ft. × 4 ins. × 3 ins., pointed and creosoted, and driven into the ground till they stand about 3 ft. 9 ins. above it. It is not necessary to put these in every 6 feet, especially if the fence is erected on the top of a bank. Every 8 or 9 feet is close enough when the fence runs in a straight line, but they can be put closer at curves. Six wires should be used, the top one being either galvanised steel or barbed. The bottom wires should be placed closer, to make certain that sheep will be excluded. Such a fence, when properly put up, the wood being well treated with preservatives, and the wires tightened from time to time, will stand twenty years.

Another fence quite capable of keeping stock out of the woods is the "dropper." The straining-posts and wires are the same as above, but the posts are put in at every 12 or 16 feet, with two droppers 3 ft. 6 ins. × 1½ ins. × 2 ins. between. This class of fence is cheaper than the former, and if well constructed is almost as effective.

Live-fences may consist either of thorn- or beech-hedges. Both are satisfactory. They are sometimes planted in two rows 9 inches apart. After the young plants become thoroughly established, they are cut over, about an inch or so above the soil, and this causes the young shoots to spring up thick and strong. It is advisable to switch them yearly into a wedge-shape until they are 4 or 5 feet high. Thorn-hedges, if properly managed, will last one hundred years or upwards, and are very effective against the inroads of both sheep and cattle. To get a hedge to grow quickly for immediate effect, it is better to trench and manure the ground well before planting. The strip trenched need not be more than 4 feet wide. Only on very stiff or wet soil is it necessary to plant the hedge on a mound. On dry, loose soil, when a bank is made, the earth crumbles away, and this, together with the burrowing of rabbits, exposes the roots, and eventually makes the hedge become full of gaps and ineffective.

(b) *Fences against Rabbits.*—Wire-netting is the most effective method of protecting young plantations against such vermin.

When rabbits abound in any great numbers, their destruction within or near the young woods is necessary to insure the welfare of the young plants. This can best be secured by enclosing the area to be planted with a wire-netting fence, and all the rabbits inside should be killed before planting takes place. When there is no permanent fence, it is necessary to erect the netting on posts driven into the ground, and to fix it on a wire stretched along the top. The netting should not be less than 1½ inch mesh, nor less than 48 inches wide, and it is best let 6 inches into the ground, to keep the rabbits from burrowing underneath. It is a good plan to let the netting lean well outwards, as this prevents climbing over the top.

2. *Draining.*—When necessary, as on deep, stiff soil, and also where stagnant surface-water exists, drains should be cut. In the formation of mixed woods, the number of these drains, and their distance apart, depends on the nature of the soil, and, to some extent, on the kinds of trees to be planted, so that no hard or fast rules can be laid down. The man on the spot is the best judge, as thorough draining may dwarf or kill one kind of tree, while it may be beneficial to another. When drains are opened on loose soil, it is necessary to cut them with sloping sides, narrowing from about 2 feet at the top to 9 inches at the bottom. On stiff and retentive soil, however, this sloping is not necessary. The soil thrown out in making the drains should be spread over the ground.

3. *Cleaning the Ground.*—Before the actual planting commences, it is advisable to get rid of all surface-weeds, such as broom, gorse, bracken, heather, bramble, briars, or other strong growth injurious to the young crop. Their presence would harm the plants, by robbing the soil of valuable plant-food, and most of them would not only hinder the proper development of the plants, but also endanger their existence, by smothering and killing them.

Broom and *Gorse* are the most troublesome to deal with. Burning them over is no use, as this only encourages them to spring from the roots thicker and more luxuriantly than ever. It is therefore best to grub out the roots in the spring, when the shoots are beginning to grow. Then the planting can take place in the following winter, as this gives the young crop a chance of getting established before any roots left in the ground can recover and make new growth injurious to the young trees.

Bracken can be considerably checked by repeated cutting during the two preceding seasons.

Heather is not so troublesome, because it can be effectively checked by burning two seasons before the ground is planted, so that the bare and caked condition of the soil will have disappeared.

Brambles and *Briars* can be got rid of by grubbing. They are not very troublesome to the young plants if cut back for two or three seasons.

On ground where there is a thick, *grassy turf*, it is often a good plan to break it up by ploughing. One plough should skim off the surface growth and turn it into the bottom of the furrow. Another plough, following in the same track, should turn over the fresh soil on the top of the turf. A crop of oats may be grown, and then the ground planted in the spring. This plan is very expensive, but it often pays, as, when the turf is 6 inches or so in thickness, the plants put in without any preparation stand a poor chance of growing well, the tree being practically starved before its roots can penetrate to the good soil beneath.

4. *Roads and Rides.*—It is necessary to mark off, before planting operations are begun, the roads and rides which are to intersect the woods. Cross-rides need not be more than 12 feet wide at time of planting and main roads 24 feet, with not more than 200 yards between them, as dragging trees for a greater distance than 100 yards to the nearest ride is somewhat expensive.

5. *Treatment of Plants in Nursery.*—It is very generally the custom, and a good one, to buy plants from public nurserymen as one- or two-year seedlings. When transplants are bought, the root-system is often found to be much deformed. But, by buying one-year seedlings and planting them in a home or temporary nursery, near the area to be planted, strong and healthy plants are obtained with a good root-system. Such seedlings should be planted in something like the following way:—Dig two or three spadings, as the case may be, across the break, and level evenly down with the back of the spade. Then set the line 15 inches in the case of hardwoods, and 12 inches for conifer seedlings, from the preceding row—and plant twelve or fifteen to the yard. The most important part of the operation is to cut the trench deep enough, and with a

straight vertical edge, so that when the seedlings are placed in position, they stand perfectly upright, and with their roots straight down, not bent round as would be the case if the cut were sloped. The roots should be well covered with soil and manure spread along the line, which should then be covered with a spading of soil, after which the seedlings should be firmed, the soil carefully levelled down, and the next row commenced. When lifted at the end of their period in the nursery, such plants will be found to have a natural root-system, well furnished with rootlets on all sides. This enables them to stand transplanting to the woods, generally to inferior soil, and perhaps also a severe exposure; whereas poor seedlings with twisted roots and bent rootlets are not able to make proper growth, and may perhaps never form a normal root-system.

6. *Planting.*—Two methods are extensively used in this country for planting trees, called (*a*) Slitting or Notching, and (*b*) Pit-planting.

Slit-Planting.—On bare hill-sides or moorlands, at a fairly high altitude, where the soil is scanty, poor, and stony, and where there is only a surface-covering of short heath or grass, slit-planting is easy, cheap, and effective. The best size of plant to use is one- or two-year-old stout and strong seedlings of larch, Corsican pine, oak, Douglas fir, and ash, while slower-growing kinds, such as beech, spruce, and silver fir should be three or four years old before being transplanted to the woods, as this enables them to be tall enough to compete successfully with the surface-growth.

Notching or slit-planting consists in making two cuts at right angles to each other, in the shape of the letters L or T, and bending the spade down, which lifts the turf, when the plant is placed in the cut underneath the spade, and on this being smartly removed, the plant is firmly trodden in.

To notch successfully, it is necessary to make a perpendicular cut, so that when the plant is trodden in it may remain upright. The cut should also be deep enough to ensure that the seedling lies with its roots perpendicular between the two surfaces of the cut, and not bent or twisted round in any way.

Pit-Planting.—On good, strong, deep, low-lying soil, with a rich surface of natural herbage, which grows 2 or 3 feet in one season, it is necessary to use large plants, tall enough, at the beginning, to compete successfully with the surface-growth; and,

as these big plants cannot be trodden in, or firmed to withstand the force of gales if slit-planted, it is best under such conditions to plant them in pits. This operation consists in making a hole about a foot square, according to the size of the plant, then inserting and holding this in position while returning the soil. It is best to place the richest soil next the roots, and all stones and coarse soil should be put at the top, when the plant should be firmly trodden in. On stiff clay soil it is usually the custom to dig the holes in autumn. This allows the removed soil, and that on the sides of the pit, to get acted on by the atmosphere. Should, however, there be any danger of the holes getting filled with water, the pitting should be left over until spring. On open, loose, porous soil, it is better to defer opening the pits till the time of planting arrives, as such soil is apt to get dried up, or washed away with heavy rains. The chief point which should be attended to in pit-planting is to make the hole deep enough to allow the roots to hang down perpendicularly, so that none of them are bent round at the bottom of the pit; because, when twisted, they very often, especially on hard soil, get water-logged, which interferes with their growth.

The size of plants suitable for pit-planting varies greatly, according to the nature of the surface-growth and the exposure, but sturdy transplants of about 2 or 3 feet in height, in the case of quick-growing kinds, is a good size. On fairly good soil, where pit-planting is adopted, the trees should stand about 4 feet apart, but on poor soil, when slit-planting is practised, the young plants may stand closer.

7. *Kinds of Trees suitable for Mixing.*—The kinds of trees which usually give the best results in mixed woods are oak, ash, beech, larch, Spanish chestnut, spruce, silver fir, Douglas fir, and Corsican pine.

Oak.—On deep, moist, loamy soil, at a low elevation, oak is almost sure to succeed, but at a high and exposed elevation it is useless to plant it. It has a decided objection to chalk, and does not like too much clay; a mixture of sand, gravel, and clay suits it well.

The oak is a deep-rooted tree, its tap-roots penetrating a good way into the soil, and therefore the advantage of planting it on deep soil is manifest. It is always advisable to have oak mixed with beech (see below).

Beech.—The beech is grown more for the benefit of other

trees, and for improving the soil, than for the value of its timber. It grows well, and to a great size, and lives to a long age on chalk, limestone, and oolite soil. The fact of its being a shade-bearer makes it one of the best trees for mixing with others. Its great density of foliage kills off side-branches, and draws up the other kinds into clean, straight trees. It annually casts off a heavy fall of leaves, the decomposition of which greatly improves the condition of the soil. It is very suitable for mixing with oak and larch. The former benefits greatly by the beech killing off lower branches, which, if allowed to grow, would check the growth at middle age.

When beech is mixed with larch, this keeps more healthy than when grown pure or with other trees.

Ash.—When grown for small timber, it is advisable to plant ash in a mixed plantation; but, when heavy timber is wanted, it requires a great deal more head-room, in its later stages of life, than can be profitably given in a mixed wood. "Coppice-with-standards" is therefore the best system for growing big ash timber. Deep, strong, moist soil, found in the bottoms of valleys and ravines, will grow ash of superior quality, and secure for it a great rapidity of growth, while dry shallow soil or peaty ground is unsuitable.

Spanish Chestnut.—This tree can be mixed profitably with other fast-growing trees, such as Douglas fir, larch, or Corsican pine. It has a very heavy annual fall of leaves, which does much to keep the soil moist, and it yields timber of high quality, little inferior to oak. But the quality of the timber deteriorates in large trees, and it is therefore necessary to cut it out as thinnings, when it is about thirty or forty years, and before it gets twisted and shaky. The best soil for Spanish chestnut is a deep well-drained loam, and deep sand or gravel. Wet or limy soil, cold and bleak situations, and frosty hollows, are all unsuitable for it.

Larch.—The larch, one of the most profitable timber-trees, is almost invariably planted in our woods. Its toughness and durability, even when comparatively young, and its clean cylindrical bole make it a great favourite for fencing, pit-props, etc. Where there is the slightest doubt as to its successful growth, it should be planted in admixture with other trees. The failure of the larch during the earlier stages of growth does not then necessarily destroy the future of the

plantation, as the other trees are there to take its place as the dominant or main crop. When the larch is to form the bulk of the plantation, the most suitable trees to mix with it are spruce on damp soil, and Spanish chestnut or beech on ordinary soil. The first is used in short rotations of thirty to forty years, and the beech in longer rotations of fifty or more years, as its timber is of little use before that time. Corsican pine and silver fir are also suitable trees to mix with larch. The larch should usually form about three-fourths of the crop, the other fourth being of one or other of the species named.[1] It is by no means easy to state definitely the soil best suited for growing sound larch. Being a shallow-rooted tree,[2] it prefers soil with a loose surface, and free from heavy surface-growth, but containing enough moisture to meet the requirements of the tree during dry summers. It is therefore on slopes of hill ranges, and in valleys where the soil consists mostly of gravel or sandy loam, loose and porous, with sufficient surface moisture, that the larch thrives best. Flat ground, where the water accumulates on the surface and becomes stagnant, is not at all suited to its growth. It should not be planted on soil too dry on the one hand, or too stiff and wet on the other; yet it is difficult to say where, at times, it will not succeed.

Spruce is suitable for being mixed with almost any other species, and it can be advantageously grown along with light-demanding trees of quicker growth. One great advantage is its ability to produce heavy timber on shallow soil with a rather moist subsoil, or on moor or heath-land, where no other tree can grow to maturity. The situation should be well sheltered, as, being a shallow-rooted tree, it is very liable to wind-fall. Hollows or valleys where there is abundant moisture suit it well.

Silver Fir is very useful in thickening up a light-demanding wood of long rotation, as it is one of the best shade-bearing trees we have. It is also useful in forming shelter. Silver fir is very apt to grow rough and knotty, which reduces the value of the timber; but, where big timber is aimed at, this is a good tree to

[1] The proper proportion in any mixture depends mainly upon local circumstances. Where the canker-disease is prevalent, no three-fourth larch admixture would likely be of much use in protecting it against infection. — HON. ED

[2] Larch is naturally a deep-rooting tree, though it can accommodate itself to stony parts of rocky hill-sides, etc.—HON. ED.

plant. It does well on damp and exposed situations, but is very sensitive to spring frosts.

Douglas Fir has come rapidly into favour within recent years, on account of its very rapid growth and the high quality of its timber. On account of the high price of the young plants, it is mixed with other species, such as spruce, silver fir, and larch, which help to check the side-branches in the early stages of its growth. On no account should the Douglas fir be put more than 12 feet apart, with the internal space filled up till the species just named stand 3 feet apart.[1] When Douglas fir is planted in this fashion, using cheaper plants to fill up the intervals, it helps greatly towards cheapening the cost of planting. Owing to the shade-bearing properties of this tree, the side-branches develop to an undesirable extent, and the chief object, if clean timber be desired, is to get it close enough to crush out these lateral branches, and so form the stem into a clean, cylindrical bole. Owing to the rapid growth of this tree, the leading-shoots are very liable to be broken and damaged by the wind in exposed situations or on high-lying ground, the tree thus becoming crooked and stag-headed. Its proper place is on low-lying ground and in sheltered valleys, away from dangerous winds. The soil best suited for its growth is deep, moist, sandy gravel, and loam of a fair depth. It does not grow well on chalk, lime, or stiff clay.

Corsican Pine can be grown either pure or mixed with larch, spruce, or silver fir, which can be taken out as thinnings; and it can be planted on something like the system recommended for Douglas fir. Plants can be put about 12 feet apart, and the intervals filled up with the subordinate species. The quality of its timber is sometimes almost equal to that of Scots pine. It has a straight, clean stem when grown close, and it grows much faster during its early years than Scots pine. It is, however, very difficult to transplant, as it has so few fibrous roots that there is often a considerable percentage of deaths, unless it is lifted very carefully. It is best to transplant it in early autumn or late in spring, and care should be taken, during the operation, that the roots are exposed as little as possible to the effects of wind or sun. The best timber is produced on soil suitable for the growth of Scots pine, such as moist, fresh gravel, although it

[1] Such close planting seems unnecessary on any class of land where Douglas fir is likely to be planted.—HON. ED.

does well also on chalk, clay, or peaty soil. It stands exposure well.

8. *System of Mixing.*—As the various kinds of mixtures are so numerous, no general rules apply to all of them, so only those above mentioned as species suitable for mixtures will here be dealt with.

When *Oak* is to form the main crop, it is best to plant it every 12 feet, so that there will be plenty to choose from when, after repeated thinnings, only the straightest, healthiest, and best trees are left to form the final crop. The distance between the oak should be filled up to about 4 feet intervals with fast-growing kinds, such as larch, spruce, ash, and Spanish chestnut, which are all able to develop into something useful by the time they are thinned out. These subordinate trees realise more money as thinnings than oak of small diameter would. Larch should always form one of the subordinate species, as its thinnings are the most valuable. Although not of much value as thinnings, beech is another tree which should be mixed with oak, to improve the soil and clean the oak stems into straight, valuable timber.

When it is intended to form the main crop, *Beech* should, like the oak, be mixed with other species more valuable as thinnings, such as larch, silver fir, ash, and Spanish chestnut.

When *Douglas Fir* is intended for the main crop, it should be planted every 12 feet, and the spaces between filled up with larch, spruce, silver fir, and Corsican pine. The Douglas grows the cleanest timber when planted pure, but in the meantime the young plants are so expensive that it is advisable to plant them mixed at this distance, and filled in with cheaper plants.

Corsican Pine, when intended to form the main crop, may be dealt with similarly to Douglas fir.

Mixing is most successful when *Larch* is intended to form the main crop, and when it is mixed with spruce, silver fir, Corsican pine, Spanish chestnut, or beech. But the last named should always (on suitable soil) form one of the subordinate species, because of its heavy fall of leaves being so beneficial.

One of the best ways of planting mixed woods is to peg off the ground into strips. Thus, if twelve men were holing or planting at 4 feet apart, that would mean every strip would be 16 yards wide. Sticks could be set up at that distance, as this would greatly help to keep the men right, and secure that the proper number of plants should be set to the acre. When slit-

planting, each man should plant at most only two species. This saves confusion, as each man knows exactly where each particular kind of tree should be put. When pit-planting is being carried on, if the holes are opened beforehand, the foreman should lay the different kinds in the holes in advance of the planters.

9. *Shelter-Belts.*—When forming large plantations, a belt of strong, deep-rooting, wind-resisting trees should always be planted round the margin of the wood. This, should the plantation consist principally of shallow-rooted conifers, will provide it with shelter from severe gales, which play havoc with exposed woods. The breadth of the belt should be about 12 yards, and it should be planted on the outside with beech, hornbeam, Corsican pine, and on the inside with silver fir, oak, and sycamore. These belts should always be well thinned to allow individual trees to develop branches over the greater part of the stem. When planted a few years in advance, these belts form, of course, a better protection for the young plants needing shelter.

II. Maintenance for Twenty-five Years after Planting.

1. *Beating-up and Cleaning.*—During the second season the plantation should be gone over and all blanks filled. For two or three years after planting, all surface-growth, such as bracken, brambles, gorse, broom, grass, etc., should be cut back once or sometimes twice in the season.

2. *Protection against Game, Vermin, and Fungous Diseases.*—

[The remarks under this head are here omitted, as merely being generalities, to be found in any text-book on Forestry, about rabbits, hares, and squirrels; the pine-weevil, the pine-beetle, the oak-tortrix, and the spruce-bark beetle; the larch-canker, the pine-rot, the common agaric, and the canker of broad-leaved trees. No attempt has been made to give special details for any given case, or to describe anything in the nature of *practical work*, as is especially desired in this class of essay.—Hon. Ed.]

3. *Thinning.*—The first thinning may require to be done from about the tenth to the fifteenth year after planting, according to the growth of the trees and the composition of the plantation. It should simply consist in going over the woods and taking out suppressed, diseased, or dead trees; but when larch has been mixed with oak or other slow-growing hardwoods, it requires to be gone over about the tenth year, in order to prevent the latter

being overdrawn and weakened. All rubbish and small suppressed trees which have been overtopped should be taken out. The hardwood rows should be gone along, and all oak, beech, etc., relieved from over-pressure of larch, spruce, etc., by cutting these back with a sharp knife. All double-leaders and strong side-branches should be cut off, so as to encourage the oak to grow up with a straight single stem. This thinning and pruning is quite sufficient to carry the plantation on for another five years or so, till the plants are about 20 feet in height. Then the first heavy thinning of the larch is made. This consists in taking out all the larches in the oak rows, leaving the oaks entirely alone. Most of the larch trees on either side are also taken out. The ash and larch rows should also be thinned, leaving altogether about a thousand trees per acre.

With shade-bearers, such as spruce, beech, silver fir, and fast-growing trees like the Corsican pine and Douglas fir, the thinning of the larch should be confined to suppressed and dead trees, as the former will suffer no injury from being in the shade, and the other will soon overtop and crush out the larch. These thinnings are quite sufficient to carry the plantation on to the twenty-fifth year.

V. *The Laying-out of a Mixed Plantation, and its Maintenance for the first Twenty-five Years.* By JOHN M. MURRAY, Assistant Forester, Murthly, Perthshire.

In planting trees, the planter looks for results, which may greatly depend upon the manner in which the work is performed at first.

Most trees take a long time to attain maturity, and it is necessary for their healthy development that the work of planting should be carried out on sound practical principles, and on a soil and situation suited to the trees forming the crops.

The boundaries for a new plantation will often depend on local circumstances, and the planter has not always the option of forming them on the most approved principles. The natural conformation of the ground, and the direction of the prevailing winds, as also the places where shelter is very much wanted, should be well studied. Where this can be done, it is advisable to give the most exposed side a convex form, as this tends to moderate the force of the wind; but, in forming a convex, it is often difficult to avoid having also a concave, and unless this concave is in a naturally sheltered situation, such an outline should be avoided.

Much can be done by a proper selection of the trees forming the margins. The chief aim in this will be the hardiness of the species, and their natural suitability to the situation. Whatever the selection may be, the plants used ought to be well-grown and well-rooted, so as to withstand severe exposure. They should always be openly grown, so that each plant will have ample room to develop strong roots and side-branches, and thus produce shelter to the plantation. If this is fully attained, the interior will be preserved, and there will be more chance of producing the best quality of timber the ground is capable of yielding.

The production of revenue, when forming plantations, should always be kept in view. As the larch is one of our most valuable trees, arriving sooner at a saleable size than most others, preference should be given to its cultivation on all situations suitable to its growth.

Waste lands suitable for planting are to be found to a greater or less extent on almost every estate, and plantations will seldom be formed on fertile soil. Indeed, with the exception of some hardwoods, such soil would not produce the best quality of timber; while the loss of rent as pasture would much exceed that of many of our hill-sides, where plantations can be raised equally well, and may even produce timber of superior quality. Timber will therefore usually be grown for profit on mountain sides or heathy moorlands, and, on a smaller scale, along the sloping banks of water-courses and in natural hollows.

The commercial value of plantations at different stages of growth may often vary considerably in different localities, according to local demand. In localities where pit-wood or other small-sized wood is in demand, it may pay best to clear the crop at, say, from thirty to forty years of age, or as soon as they attain the size best supplying the local market. Many situations suitable for the growth of larch and other valuable trees are not sufficiently accessible for the removal of heavy timber, and then it may be more profitable to clear the crop when it is of handy pit-wood size, and replant. In this way two crops of timber may be grown in the time taken to grow one of heavy matured timber, which would lock up more capital meanwhile. These are, however, matters only for local consideration.

Fencing.—Before commencing to plant any piece of ground, it must be securely fenced against the inroads of stock or game. The manner of enclosing plantations varies, and often depends on local facilities. Where suitable stones abound, no more lasting fence can be erected than a dry-stone dyke, built to the height of 3 feet, and surmounted with iron standards placed at 9 feet apart, using three lines of wires placed at 7, 8, and 9 inches apart. Where the fence is a straight line, these standards may be placed at 18 feet apart, using two droppers at 6 feet apart. Corrimony fencing is efficient, cheap, durable, easily erected, and therefore suitable for hill-ground and places difficult of access. Straining and tie-pillars should be of good malleable iron, 1½ inch square, placed not more than 150 yards apart. These should be fitted with stays in line of fence, and also with iron plate ratchets. The intermediate posts should be of T iron, 1½ in. × 1½ in. × ¼ in., placed at 18 feet apart, using two droppers between at 6 feet apart. Strainers and T irons to be

sunk full 4 inches into sufficiently large stones, and fixed with melted sulphur.

No proper fence to resist sheep or cattle can be made with less than six lines of wire, which should be either of best galvanised strand or solid.

There are also many forms of wire-fences erected on wooden posts, which can be erected and kept in repair conveniently and at small cost.

Where rabbits and hares abound, it is necessary to attach rabbit-proof wire-netting. This adds to the cost of fencing; but, with wire-netting, two at least of the six lines of wire can be dispensed with.

Draining.—Next comes the draining of the ground. Although a certain amount of moisture is necessary for the healthy production of forest trees, yet excess of water is highly detrimental, and must be removed by drainage.

On wet, marshy land, where water lies and turns sour and fœtid, drainage ***must*** be resorted to, as land surcharged with stagnant water does not promote the healthy growth and development of plants. Drainage should there be carried out at least two years before planting, in order to promote aeration and permit rain-water to penetrate into the soil and fertilise it. When freely admitted, air and rain-water promote decomposition of the mineral and organic substances in the soil, and render them fit to be absorbed by the plant-roots.

There are usually many parts that, with a proper selection of the plants, will not require drainage. But where there is an excess of moisture, more especially where the ground is flat, the water then becomes stagnant and must be removed.

In laying out the drains, advantage ought to be taken of existing water-courses. As these generally follow the lowest parts of the ground, they form, if properly scoured, the best leaders or mains. The smaller drains may be led into these at any angle, provided the fall is not so rapid as to cause the drains to get cut up, as is more especially the case if the ground is gravelly.

It is impossible to lay down any hard-and-fast rule as to the number, depth, and division of the drains, as this must altogether depend on the nature of the soil and the amount of water to be carried off.

When ground is rendered wet by an excess of water coming from a higher source, much benefit can often be derived by a

system of catch-water drains. If these are properly arranged, whole tracts of ground formerly wet can often be rendered sufficiently dry for the production of a timber-crop.

The usual size of plantation-drains on the Murthly estate (Perthshire) is 36 inches wide at the top and 24 inches deep. The width at the bottom is not more than the breadth of a common spade.

Whatever depth the drains are cut, the sides should be allowed an easy slope so as to prevent their falling in, and to allow of easy cleaning when necessary.

Roadways.—Good roadways will always add to the value of plantations. Though it may not at first be necessary to have them permanently laid down, their lines ought, however, to be fixed previous to planting, as at this stage the best direction can be easily determined. Their further construction can be done at any time previous to the removal of timber. It may, however, be advisable to cut a ditch along each side of the roadways, as this will keep them at all times in a moderately dry condition. An advantage of roadways or open lines is the facilities they afford for battue-shooting.

Planting.—The ground being laid out, fenced and drained, the next matter of importance is the selection of suitable kinds of trees for the given soil and situation. Climate, soil, and shelter may vary considerably in different localities, hence the necessity of having a proper selection of suitable species for the various soils, altitudes, and exposures to be met with.

To plant with success, many difficulties have to be contended with. The destruction by game on many estates is very discouraging. Although rabbits and hares may be excluded, in some localities blackgame and capercailzie often do much damage to pine by picking out the leading buds, and thus causing stunted and misshapen trees. Another difficulty with which one has often to contend, owing to our extensive sea-board, is the particles of sea-salt, particularly injurious to evergreen trees and shrubs, that are carried by the wind and deposited on leaves and branches. By a proper selection of the species for seaside planting this danger may be partially overcome, as some trees have the power of resisting the injurious effect of sea-salt on their growth.

The selection of the best kinds of trees for the various soils and situations is, of course, a matter of the first moment, yet there is

no error more commonly made than the indiscriminate distribution of the different kinds. To this error much of the unhealthiness of some plantations is due, and then the young trees soon become diseased and die off rapidly. When the natural peculiarities of the plants and the causes of disease are properly understood, the plantations will be healthier and more profitable than if formed merely in a hap-hazard fashion. But almost equally important is the planting of trees that will produce timber saleable in the locality: and the planter should consider beforehand at what age the crop can probably be most profitably cleared, in order that he may adopt a system of management well suited to the circumstances.

Deep heathy soil is usually best suited for the Scots pine, and low-lying and moist situations for spruce and other firs. Probably the Douglas fir will be considered the most valuable of these. It is certainly a free grower, and forms a large quantity of timber in a short time. It will thrive on a great variety of soil, and should generally form one of the trees in a mixed fir plantation.

Many kinds of pine may be planted with confidence on soil not sufficiently good for the production of valuable deciduous trees. In Britain it has often been found difficult to form plantations on ground that has previously grown a timber-crop, and especially when old stumps afford breeding-places for injurious insects. In such cases it is better to defer planting for some years after the ground has been cleared.

In a well-mixed plantation the trees comprising it do not all extract their food from the same distance below the surface of the soil. As is well known, the roots of some trees penetrate deeply, while others have their roots near the surface; and by a proper selection the soil is thus more completely utilised. Deciduous trees gain by having evergreen conifers intermixed with them, the shelter thus produced being beneficial in protecting the soil, while the side-shade tends to prevent any extensive formation of side-branches, and has thus the direct effect of rendering pruning unnecessary, and of producing long, clean, valuable timber.

As the influence of different altitudes is always evident in the growth of trees, the situation must be considered as well as the soil. The oak will generally succeed best on deep and somewhat stiff clay soil. Ash will grow most freely on a deep loamy soil, on steep declivities, or in deep ravines. A dry and

moderately fertile soil will best suit the elm; and from its straggling habit of growth it may require considerable attention in a mixed plantation. Beech thrives on any moderately dry land, and is not particular as to soil or situation: it forms one of the best mixtures along with either oak, ash, Scots pine, or larch. Sycamore will thrive on any soil not wet or boggy, and may be planted with beech, spruce, or Weymouth pine. The Spanish chestnut thrives best in rich dry soil, and grows much quicker than most of the other kinds of trees. The banks of streams or water-courses, and moderately damp situations, are suitable for common spruce, alder, poplars, and willows. Of the newer Coniferæ suitable for mixed plantations, perhaps none is better than the Douglas fir; and in favourable situations such kinds as *Tsuga Mertensiana*, *Cupressus Lawsoniana*, *Thuya gigantea* (*Lobbii*), *Larix leptolepis*, and *Abies grandis* may be planted. In planting for profit, large plantations should be made, as they can usually be formed and managed at less cost proportionally than small areas, and also produce finer timber. On light land suitable for notching, from 3500 to 4800 plants should be used to the imperial acre.[1] The usual method of notching should be adopted where plants are of a suitable size, care being taken that the slits into which the plants are inserted are firmly closed. Where plants of large size are used, including all hardwoods, pits may be made for their reception. The extent of the roots will determine the size of the holes to be made, an allowance being made of a few inches beyond the extreme points of the roots.

The success of the plantation will depend on the skill exercised at this stage. All kinds of trees must be planted with care, on soils and situations suited to their growth, without regard to regularity. Light-demanding kinds should be mixed with shade-bearers of less rapid growth, or should be planted in advance.

In addition to our ordinary woodland trees in Britain, *Tsuga Mertensiana*, *Cupressus Lawsoniana*, *Thuya gigantea* (*Lobbii*), *Abies grandis*, *Picea sitchensis*, and *Larix leptolepis* may also be planted

[1] That is, from 3 to 3½ feet apart. Except where the land is suitable for notching, or unless there are special reasons for close planting, it will seldom pay best to plant closer than 4 feet (2722 per acre)—and that, too, even in localities where there may be a fair demand for early thinnings. But we have, unfortunately, as yet no statistics for comparison of actual results in Britain. —HON. ED.

as subordinate species on suitable land. These are valuable timber-trees, which deserve a trial, and many often prove profitable additions to the crop.

Maintenance for Twenty-five Years.—For several years after planting, the plants may require to be kept free from weeds of all sorts, and failures will have to be replaced. For this latter purpose, where the situation is at all suitable, perhaps nothing will succeed better than Douglas fir and sycamore, which are of rapid growth, and can stand side-shade. The fencing should also be frequently inspected, to prevent damage by stock or game. All open drains or water-courses should be seen to, so that no obstruction interferes with the free motion of water. Damage by ground-game should be carefully looked for, and exterminative measures promptly taken in hand. All plants, especially the hardwoods, should be looked after for a number of years, and double-leaders and disproportionate branches cut back. Double-leaders in conifers, when within reach, may be checked by nipping out the side-buds.

Thinning constitutes the next operation. If the plantation has been judiciously formed and well attended to hitherto, the manner in which thinning is performed will greatly influence the future value of the produce. There is no definite age when thinning should become necessary, nor can any distance be laid down as that at which the trees should stand apart. This depends on the increase in height, and the individual growing-space required by each kind of tree, while soil, altitude, and exposure also occasion inequalities in the growth, and exert their own special influence affecting thinning.

A certain proportion of healthy foliage is at all stages of growth necessary for the production of a sound and valuable crop of timber. But, on the other hand, if the trees stand too wide apart, or thinning be commenced too early, thus allowing the branches of each tree to become strong and spreading, the timber produced will be coarse and open in the grain, and full of large knots or even black holes. In thinning, the principal object ought always to be to assist nature to produce the best class of tall, clean, and well-formed timber, with few branches, by keeping the trees close enough to check the growth of unnecessary side-branches. The lower branches will then gradually die and fall off, and when the mature timber is cut up, it will be found to be clean and close-grained.

As most of our forest trees are liable to accidents and diseases, it is necessary, when thinning, to remove those of poor growth, or showing signs of premature decay. Those left should be the largest and most promising trees, and though they may not stand at regular distances apart, this can be rectified during successive thinnings. When trees have stood long enough in close canopy to be drawn up tall, clean, and straight, it will then be advantageous to thin gradually, before they become too tall and slender in proportion to their girth.

The intervals at which thinnings should take place depends on the kinds of trees, closeness of planting, soil, and situation. Trees differ in their requirements for growing-space, and other factors also exert their own special influence. Care should be taken not to interrupt close canopy unnecessarily by removing too many trees at one time, and thus unduly exposing the soil to the effects of wind and sun.

In timber-crops grown for profit, the thinnings should be made so as to benefit the most promising trees, because excessive thinning at this stage often means future loss on the mature crop. When our timber is by chance or good management grown in close canopy, it is equal in quality to imported timber, and can be applied to much wider uses than at present.

The first thinning of hardwoods mixed with conifers is a simple operation, consisting principally in the removal of some of the conifers. As fast-grown hardwoods are much more profitable than slow-grown, their growth should be encouraged by opening out the crop as soon as, and so far as, this can be done, while still keeping the formation of unnecessary side-branches in check; but, of course, healthy conifers should be retained where the hardwoods show signs of failing health.

The margins of plantations require different treatment as to thinning, as the trees are here intended to form a barrier to the wind, and give shelter. It will therefore be necessary to thin before the trees get crowded and lose their side-branches, because these should be preserved and encouraged from the very earliest stages, so as to provide shelter to the interior of the plantation. When margins are formed of hardy trees, clothed to the ground with healthy, well-balanced branches, they resist violent gales, and prevent the wind from sweeping underneath, carrying away the dead leaves, and depriving the crop of nourishment.

VI. *Megastigmus spermotrophus*, Wachtl, *as an Enemy of Douglas Fir* (Pseudotsuga Douglasii), with two Plates.

By R. STEWART MACDOUGALL, M.A., D.Sc., F.R.S.E., Hon. Consulting Entomologist to the Society.

In the month of May 1905 I received a number of seeds of the Douglas fir that had been sent by Mr John Crozier, Forester, Durris, Aberdeenshire. Accompanying the seeds were some insects that had issued from them. The insects, on examination, proved to be *Megastigmus spermotrophus*. From these seeds and from others I bred out a number of males and females of this species. The infested seed had been rendered useless by the destructive work of the *Megastigmus* larvæ. In the letter containing the request for determination of the insect and how to combat its ravages, Mr Crozier wrote: "The insect has, for some years back, been causing a serious loss to our stock of Douglas fir seed. I noticed its presence on coming here nine years ago, but it had no doubt been in the estate before that time. Seed was plentiful, however, and as the damage was comparatively trifling, I did not pay much attention to the fact. Now, however, it has assumed a more serious aspect, as the seed on many of the older trees from which I formerly collected my supply, in good years amounting to over 300 bushels, is not worth the trouble of gathering. I have raised some millions of plants on this estate, but unless this pest can be kept in check, it will be impossible to keep up the stock from home-grown supplies."

A number of points render this communication of Mr Crozier's interesting.

In the first place, this is the first record of the insect in our country. Mr W. F. Kirby very kindly wrote me to say that while two other species, *Megastigmus collaris*, and the large Californian species, *Megastigmus pinus*, were in the Collection at the Natural History Museum, the present species, *M. spermotrophus*, was not represented.

The insect occurs, too, as an enemy on a tree of great value, both for ornament and for timber, and justly regarded as one of the most important trees introduced in the last century. Although introduced into Britain only seventy-eight years ago, there is a specimen in our country 130 feet in height, and thick

in proportion. Again, *Megastigmus spermotrophus* belongs to a family of Hymenopterous insects, the *Chalcididae*, the larvæ of which, in the great majority of cases, are not feeders on plants, but are parasitic on other insects. Further, while it is admitted that *some* species of Chalcids are feeders on plants (phytophagic), it has been denied by such an excellent authority as Dr L. O. Howard, of the United States, that species of the genus *Megastigmus* are phytophagic in habit. We believe that the record of this infestation at Durris should go far, in view of previous evidence, to settle the controversy.

This insect, *Megastigmus spermotrophus*, was first received by Wachtl, of Vienna, in 1893, and was described by him as a new species. In the spring of 1893 Wachtl got some specimens of *Megastigmus* insects that had issued from the seeds of the Douglas fir. From these specimens Wachtl described the male and female of the species, which description I now give, in translation, from Wachtl's paper.[1]

"The female is loam-yellow; the vertex of the head and the forehead to the base of the antennæ are red-brown; the central part of the face (epistome), the inner edges of the eyes and the palpi, yellow; the ocelli red-brown, each edged with black and sometimes connected with one another by means of black lines; never, however, is the entire inner surface of the ocellar-triangle dark coloured; the eyes during life are shining coral red, after death red-brown; antennæ blackish-brown, the scape, and the part between the scape and the flagellum, reddish-yellow; the pronotum with a more or less broad yellow band at the hind edge; the scutum of the mesonotum generally red-brown; the outer side of the shoulders and the furrows of the parrapsides[2] yellow; the surroundings of the bases of the wings to a slight extent black; the diaphanous wings finely black-haired; the knob or club of the ramus-stigmaticus[3] longer than broad,

[1] *Ein neuer Megastigmus als Samenverwüster von Pseudotsuga Douglasii*, Carr., *Wiener Entomol. Zeitung*, 1893.

[2] The scutum or disc of the metathorax is, in the order Hymenoptera, divided into three parts by longitudinal sutures or furrows. The name parrapsides is applied to the side parts separated from each other by the middle portion.—R. S. M.

[3] The ramus-stigmaticus is the small branch (see Figure) which is given off from the part of the vein that runs along the front edge of the fore-wing. Its varying size and shape in different species are made use of in classification. —R. S. M.

elliptical and black; the coxæ of the fore-legs yellow; the pulvillus on all the legs black; the compressed abdomen reddish-brown on the upper side, with a larger or smaller black-brown or black spot at the base of the first segment, and becoming paler at the edges—this spot is sometimes wanting; on the other hand, the end of the body and the under-surface of the abdomen are somewhat light coloured; the sheath of the ovipositor is intense black.

"All the flagellum joints of the thirteen-jointed antennæ are longer than thick, and become gradually a little less thick towards the apex of the antennæ; the first joint is the longest, the others practically agree in length; the three-jointed club is egg-shaped, and as long as the two foregoing joints taken together. The central part of the face is obliquely wrinkled, the forehead longitudinally wrinkled; the vertex of the head, the prothorax, the mesothorax, and the scutellum are transversely wrinkled; the post-scutellum, outlined by a fine deep line, is glossy and smooth, except at the base and along the longitudinal middle line, where it is finely punctured; the metanotum is finely punctured, with a prominent longitudinal keel in the middle, and, in the case of most examples, with a transverse ledge at the limit of its front third; the hind margin is glossy smooth, without sculpture. The face, mesonotum, all the coxæ, the tibiæ and tarsi of the forelegs, and the middle and hind legs, are white-haired; the vertex of the head and the forehead, the thorax, especially both sides of the furrows of the parrapsides, the scutellum other than the post-scutellum, the femora of the fore-legs, and the hind edges of the segments of the abdomen, are beset with longer or shorter black bristles. The ovipositor is as long as the body. The body-length of the female measures from 3·25 mm. to 3·5 mm. (= roughly $\frac{1}{8}$ to $\frac{1}{7}$ of an inch).

"The male is orange-yellow; antennæ, reddish-brown; the pronotum has, in the middle of the front edge, a black transverse patch, which is somewhat elongated behind, in streak-like fashion, in the direction of the middle line, sometimes resolved into two spots or reduced to two points; the scutum of the mesonotum is reddish-yellow, and provided in front with a black-brown spot, paler behind, which sometimes only shows through the hind end of the pronotum more or less clearly; the bases of the wings and the metanotum are black; the tarsi of the fore-legs, as well as the middle and hind legs, are reddish-yellow;

the strongly compressed abdomen is brownish-red above, with a black longitudinal patch at its base, gradually narrowing behind and becoming paler at the edges. Sculpture, hairing, etc., as in the female. The body-length of the male measures from 2·75 mm. to 3 mm." ($=\frac{1}{9}$ to $\frac{1}{8}$ of an inch).

So far as I know, the larva has not till now been described. It is whitish in colour, and legless. The segments are well marked, and, indeed, the general appearance, including the wrinkled and curled form, is strongly reminiscent of a weevil grub. The marked horny head of the weevil grub, however, is absent. Instead, in the *Megastigmus* larva, each of the two chitinised gnawing jaws is somewhat sickle-shaped, the two jaws together reminding one of a pair of calipers. The apex of each jaw is pointed, and on the concave side is provided with marked teeth. These gnawing mouth-parts are red or yellow-brown in colour. Those shown in Figure *e* were drawn under a magnification of about 750.

Life-History.

The flight time of *Megastigmus spermotrophus*, under normal conditions, is, in Scotland, from May onwards. The females that have issued proceed to their egg-laying in the young Douglas fir cones. The insects may be seen at this time on the Douglas fir trees, as also on the top of the seed-beds, some time after sowing, these last having most likely issued from seed which had been sown.

Each infested seed of the Douglas contains only one larva, which nourishes itself on the reserve contained in the seed. The seed bears no external mark of the internal presence of the *Megastigmus* larva. Pupation takes place in the seed, there being no cocoon. In a number of the seeds which I dissected, and from which *Megastigmus* adults had issued, the contents of the seed had been devoured, and only the outer brown testa or seed-coat remained surrounding the inner white-coloured perisperm sheath. In other seeds, on dissection, I found the larva, and, where it was full-grown and the seed contents destroyed, the white-coloured perisperm-sheath surrounding the larva bore a close resemblance to a cocoon.

Starting from the first laid eggs of the spring brood of *Megastigmus*, the generation, probably, can be reckoned as an annual one. From Douglas fir seeds received in May, I bred out males

and females during May and June. Seeds of the same age dissected then also revealed larvæ. In dissection of seed during July, August, September, and October, I never failed to find healthy larvæ, and now in November I can still get larvæ, and all this with seed-material from Douglas fir cones harvested in October 1904, and having their seed extracted in spring 1905. This can probably be accounted for partly by the considerable irregularities in time of hatching of eggs and coming to maturity known to occur in other insects with eggs laid at or about the same time, partly perhaps by the life of the individual *Megastigmus* being somewhat extended, or perhaps also by the overlapping of generations, with issue of adults at different times during the summer. An endeavour will be made in 1906 to clear up some of these points in the biology.

Wachtl, in Central Europe, bred out, in 1893, from seeds of the Douglas fir, from March 30 to May 4, a large number of *Megastigmus spermotrophus* of both sexes, the females predominating. Mr Crozier got in ten days, from seed blown through the fan in dressing or cleaning, 182 adults, of which 142 were males. It is possible that this excess of males may be due to the fact that the males being smaller than the females, the seeds enclosing the males, being somewhat lighter, would be the more likely to be blown through in dressing. I bred out from a very small quantity of seed, in May and June, thirty females and nineteen males.

The native home of the Douglas fir, known also as the Oregon pine and Columbia redwood, is Western North America, where it extends over an area of 50,000 square miles, between 43° and 52° latitude. *Megastigmus* has doubtless been introduced to Britain in seed from the native home of the tree. To what extent the insect may be present in Britain we cannot yet estimate, as comparatively few estates take advantage of the seed produced on the Douglas firs grown on them. I would be very glad, however, in view of a later communication, to receive material of Douglas fir or other cones for examination from any estate.

Protection and Remedy.

The insects are so small, and the number of cones on the Douglas may be so great, that direct measures to prevent egg-laying do not seem very practicable; yet it is worth keeping in

mind that close allies of these insects are considered as amongst the easy prey of the collector, good hauls being got by netting, and by sweeping and beating the trees. Such sweeping or beating, where *Megastigmus* brought itself within reach, would be certain to account for numerous adults. Any adults seen on the seed-beds should also be destroyed. As against the insect in its various stages in the seed, measures can probably be adopted with success.

The cones should be gathered as soon as ripe (the latter half of October), and should at once be subjected to such treatment as will permit of the seed being abstracted. This seed should, without delay, be fumigated with bisulphide of carbon. The method is as follows:—Place the material to be treated in an air-tight receptacle. Pour the bisulphide of carbon into a saucer or saucers, or such shallow dish, and lay these *on the top* of the material. Close the receptacle. The bisulphide of carbon vaporises, and as its fumes are heavier than air, they sink down through the material. The receptacle should be kept closed for forty-eight hours. One ounce of bisulphide of carbon will do for 100 lbs. of seed, or one ounce for every 50 cubic feet of air space. The treatment should be administered in not too cold a temperature. Bisulphide of carbon fumes being poisonous should not be inhaled by the operator, nor should a light of any kind be brought near. If it is desired to store the cones during winter or longer, these must be similarly fumigated directly they are gathered.

The results to be looked for from fumigation are:—

1st. The germinative capacity of such seeds as have not been infested is not interfered with.

2nd. In infested seed, where the larvæ may not have made much progress in the destruction of the reserve in the seed, the larva will be killed and the seed may germinate.

3rd. In infested seeds, where the contents have been altogether or much destroyed by the larvæ, and which therefore would not have germinated, the larvæ will be killed and the issue of the next year's brood of adults prevented.

The light seed blown through by the fan at cleaning time should be burnt at once, and where there has been attack this will probably account for many of the pests.[1]

[1] The foregoing, along with the Figures, was published in *The Journal of the Board of Agriculture* for January 1906.

Is Megastigmus a *direct* Enemy of the Seed?

It has been already stated that one feature of interest in connection with this *Megastigmus* infestation is that the insect is one of the *Chalcididae*. It has been admitted now for some years, practically by all entomologists, after great controversy, that certain Chalcids are feeders on plant-tissue, but controversy still exists about the genus *Megastigmus*. A review of the *Chalcididae* and the controversy may prove useful.

Position of the Chalcididae in the Insect World.

The well-known order of insects—the Hymenoptera, with its tens and tens of thousands of species, is divided into two suborders, one whose members feed on plants, *e.g.*, the saw-flies and the wood-wasps. The other suborder, far greater in number of species, is known as the *Petiolata*, from a constriction between thorax and abdomen. To this suborder *Petiolata* belong the bees, ants, wasps, and ruby-wasps, and a great series known as the *Parasitica*.

The series *Parasitica*—so called because of the frequency of the parasitic habit amongst its members—is divided up into families, of which the *Chalcididae* is one. The other well-known related families are the *Cynipidæ* or Gall-flies, the *Ichneumonidæ* or Ichneumon Flies proper, and the *Braconidæ*. Many of the *Cynipidæ* give rise to galls on plants, and their larvæ live in the galls caused by the pricking and egg-laying of the adult; others of the *Cynipidæ* live as guests in these galls. Some of the *Cynipidæ*, however, do not feed on plant-food, but are parasitic on other insects. This difference of economy among members of the same family should be noted.

The *Ichneumonidæ* is a very large family with larvæ of parasitic habit, most of the larvæ living within the body of their victims. The *Braconidæ* are very like the last, but are marked off from them structurally by differences in the wings. Like the Ichneumons, however, the larvæ of *Braconidæ* are parasites.

The *Chalcididae*, named from the metallic lustre of their chitin covering, is a large family very rich in species. Some species reach a length of $\frac{3}{8}$ inch, but the great majority are minute insects, some very minute.

Life-History and Habits of Chalcididae.

The great majority of the *Chalcididae* are parasitic on insects. Eggs may be parasitised, as in some of the cockroaches, or pupæ may be infested, but far the commonest stage for infestation is the larva. The larval host may be a gall-maker, or a guest in a gall, or a feeder in a mine or burrow in the plant, or an external feeder.

The female Chalcids lay their eggs on or in the host. In the majority of cases the larvæ, on hatching, feed internally. If the larval host feed enclosed on plant-tissue, the Chalcid parasite may feed externally on it. There are a few cases known where the parasitic Chalcid larva feeds externally on an external feeding host. When full grown, the parasitic larva passes into the pupal stage without making a cocoon.

The range of insect host parasitised by Chalcid larvæ is a very wide one. Scarcely any insect Order escapes. Dr L. O. Howard points out[1] that the non-parasitised insects, the May-flies and the Dragon-flies, and Thrips and *Thysanura*, are either aquatic forms in their early stages, or very tiny land forms.

Following Howard, the commonest orders parasitised are the *Lepidoptera*, the *Hymenoptera*, and the *Hemiptera-Homoptera*. The caterpillars of *Lepidoptera* are very commonly parasitised, those of the Micro-Lepidoptera more often than of the Macro-Lepidoptera. Among *Hymenoptera*, the bee section, the gall-flies and the saw-flies all suffer, while Chalcid parasites are also found infesting Ichneumonids, Braconids, and even other Chalcids.

Of the *Hemiptera-Homoptera*, the Scale insects, Aphids and *Psyllidæ* are much infested.

Of the remaining insect Orders, a number of beetle-families provide Chalcid hosts. Of the *Diptera* we find Chalcid parasites levying toll on the gall-gnats (*Cecidomyidæ*), the crane-flies, and the *Muscidæ*. *Orthoptera* also suffer, and among the *Neuroptera* the ant-lions and the predaceous lace-wing flies.

While it is not possible to say absolutely that each Chalcid section confines its parasitism to a special family of insects, yet one can say that certain of the Chalcid genera affect, and even limit their parasitism to, specially chosen families.

[1] "Biology of the Chalcididae, 1901," *Proceedings United States Nat. Mus.*, vol. xiv. By Dr L. O. Howard.

Habit of Life.

While the vast majority of the *Chalcididae* then are parasitic on insects, there are some which have a phytophagic or vegetarian habit. Over half a century's controversy has taken place regarding this phytophagic habit, but now entomologists are agreed that in the genus *Isosoma* and closely-allied genera at least, vegetable-feeders are found.

The Genus Isosoma.

Scattered up and down in entomological writings in the United States and Canada, from 1834 onwards, are observations by Harris, Fitch, Cadell, Walsh, Pettit, Riley, and Howard on the food-habits of *Isosoma*.[1] Howard gives the date 1882 as the time by which all entomologists were agreed as to the phytophagic habit of *Isosoma*.

Recently Mr F. M. Webster[2] has enumerated sixteen North American species of *Isosoma* whose larvæ are directly injurious to wheat, barley, rye, or other grasses.

An interesting feature in the biology of the Greater Wheat Straw-Worm is chronicled by Webster, this species showing in its life-history an alternation of generations—a spring generation, wingless and small in size, alternating with a winged summer generation larger in size. The importance of a knowledge of life-history is well illustrated here, for as the spring generation is wingless it can be fought by changing the crop.

The following three genera, related to *Isosoma*, are stated by Howard, from notes in the Division of Entomology of the United States, to be gall-makers—*Eurytomacharis*, Ash., *Isomorpha*, Ash., and *Philochyra*, Hall.

Outside of American literature we have various records. Westwood, in the *Gardeners' Chronicle*, 1869, records a Chalcid, the pupæ of which he took from an orchid. Certain curculionid grubs were feeding on the orchid leaves, but Westwood, believing that the Chalcid had been feeding not on these grubs but on the plant itself, suggested for the Chalcid the name *Isosoma orchidearum*.

[1] Formerly several of the forms now named *Isosoma* were named as of the genus *Eurytoma*.

[2] U.S. Department of Agriculture, Division of Entomology, Bull. No. 42, 1903—*Some Insects attacking the Stems of Growing Wheat, Rye, Barley, Oats*. By F. M. Webster, M.S.

Trail in Scotland, and Ritsema Bos in Holland, had recorded in 1870 and 1871 *Eurytoma* (which Howard says should be named *Isosoma*) *longipennis* as the cause of galls on Sea Marram or Mat Grass (*Ammophila arundinacea*).

In 1880 Lindeman[1] described a species of *Isosoma* which had, over a period of five years, been harmful to rye.

Westwood, in 1881,[2] recorded an instance of Chalcid larvæ causing damage to the buds of a specimen of *Cattleya* by boring into these and destroying the heart of the shoot.

Again, in 1883, Westwood claimed *Eurytoma taprobanica* as a gall-maker on *Ficus*, but Howard dissented, believing it to be really parasitic in habit.

Amongst the subfamily *Torymidæ*, the subfamily to which the genus *Megastigmus* belongs, are some of the fig-insects well known in fig-caprification.

The Genus Megastigmus.

A controversy, similar to the one that existed with regard to the food-habits of *Isosoma* species, exists as regards some of the *Megastigmus* species. The genus *Megastigmus*, of the subfamily *Torymidæ*, is characterised by this, that in both sexes the tiny vein, which is given off as a branch from the part of the vein that runs along the front edge of the forewing, is very short, and ends in a marked knob or club. The females, too, have a long ovipositor.

There seems to be no doubt that certain of the *Megastigmus* species are parasitic on insects. Mayr,[3] for example, mentions *Megastigmus* species that are parasitic on the larvæ of numerous Cynipid galls and on species of caterpillars of *Lepidoptera*. Ashmead[4] names *Megastigmus* species taken from Cynipid galls and from a Cecidomyid gall. There is a considerable body of evidence, however, in favour of the phytophagic habit of several species. Wachtl[5] obtained from rose-hips a number of *Megastigmus collaris*, Brh., and *Megastigmus pictus*,

[1] *Bulletin de la Société Imperiale des Naturalistes de Moscow*, 1880.

[2] *Gardeners' Chronicle*, vol. xvi. p. 567.

[3] *Die Europaischen Torymiden*, 1874, Mayr.

[4] "Studies of North American Chalcididæ," Ashmead, *Tr. Am. Ent. Soc.*, vol. xiv., 1887.

[5] *Wiener Entom. Zeitung*, iii., 1884, pp. 38 and 214.

Först. Up to the time of Wachtl's published statement, these *Megastigmus* larvæ had been considered to be parasitic on the larvæ of a *Trypeta* moth that had also been found infesting the rose-fruits. As a result of many observations, Wachtl recorded that he had no doubt whatever that the two different species of *Megastigmus* larvæ were direct feeders on the rose-fruits and not parasitic on any insect. Howard[1] expressed doubt as to the vegetarian habit of these larvæ, believing rather that the *Megastigmus* larvæ had previously fed on and destroyed the true enemy of the rose fruit and seed, and stating in support of his belief that he himself had found the larvæ of *Eurytoma funebre* in the seeds of clover, in which they had been feeding on the larvæ of *Cecidomyia leguminicola*, the real enemy of the seed, which larvæ the Eurytomes had quite destroyed. More recent investigation, however, has shown that the clover seed Chalcis fly, *E. funebre* (now known somewhat unhappily as *Bruchophagus funebris*), is an undoubted enemy of clover and alfalfa seed, and a more dangerous one to the clover seed than the clover seed midge (*Cecidomyia leguminicola*).

Mr E. S. G. Titus,[2] with specimens of the clover seed Chalcis fly, reared from clover seed, placed these on isolated clover plants, and was able to work out the life-history. This Chalcis fly lays its eggs on the young forming clover seed, and its larva, on hatching, feeds on the seed contents, these being practically used up by the time the larva is full fed. Pupation follows in the hollowed-out seed. In some cases the Chalcis larva was found to attack more seeds than one. Previous to this experiment, Hopkins, in 1895, had expressed the opinion that the above Chalcis fly was a very destructive enemy to red and crimson clover.

Of other species, *Megastigmus brevicaudis*, Ratz., has been reared by Bouché from the fruits of the rowan (*Pyrus Aucuparia*), and *M. pistaciæ* from the fruits of *Pistacia Lentiscus* and *Pistacia Terebinthus*.

Megastigmus and Needle-leaved Trees.

In the spring of 1893 Wachtl received from a friend specimens of a *Megastigmus* taken from the seeds of the Douglas fir.

[1] *Proc. U.S. Nat. Mus.*, Washington, 1892, vol. xiv. p. 576.
[2] *U.S. Agr. Rep.*, 1904, p. 77.

Wachtl, after an examination of these dead specimens, obtained a number of Douglas fir seeds, and found them infested with a larva. The seeds showed no trace of any other inhabitant save the Chalcid larva. Wachtl bred out many adults of both sexes, and described the species under the name of *Megastigmus spermotrophus*. The seeds from which the specimens were obtained had been imported from the American home of the Douglas.

Wachtl, by publishing his observations, definitely stating the *Megastigmus* larva to be the seed destroyer, obtained priority as regards the discovery of a *Megastigmus* destructive to conifers. Several other observers, however, previous to 1903, had noticed Chalcid larvæ in, or bred out adults from, the seeds of different conifers, but their observations remained unpublished, or they took the old view that the *Megastigmus* was parasitic on the real enemy of the seed, whatever it might be. The late Professor Nitsche, of Tharandt, had in his possession a letter written to his colleague, Professor Judeich, in 1887, by Mr H. Borriès, of Copenhagen, stating that there had been a marked destruction of the seeds of the silver fir (*Abies pectinata*) at Bornholm, in Denmark, and that from the seeds Borriès had bred out many *Megastigmus strobilobius*, Ratz. Long before this, Ratzeburg, in Germany, had obtained from the seeds of the spruce (*Picea excelsa*) a *Megastigmus*, but disbelieving in the plant-eating habit of *Megastigmus*, he stated that this larva from the spruce was probably parasitic on *Grapholitha strobilella*, a caterpillar enemy of spruce cones.

Borriès had also written to Riley, in America, a letter relating to the appearance of *Megastigmus* adults from the seeds of different conifers. In this letter to Riley, Borriès writes:[1] "During the year 1886 and 1887, the seeds of *Abies pectinata*, in the forests of Denmark, were destroyed so thoroughly that not a single healthy seed could be found. Cones which were sent to me for examination did not show anything peculiar externally, but the apparently healthy seeds contained each a small larva of the subfamily *Torymidæ*. From two tons of cones, kept in cages, only a single species of Torymid developed from this larva in spring 1888, viz., *Megastigmus strobilobius*, Ratz., which had been entirely lost sight of since Ratzeburg's time."

Borriès had also had occasion to procure the seeds of a

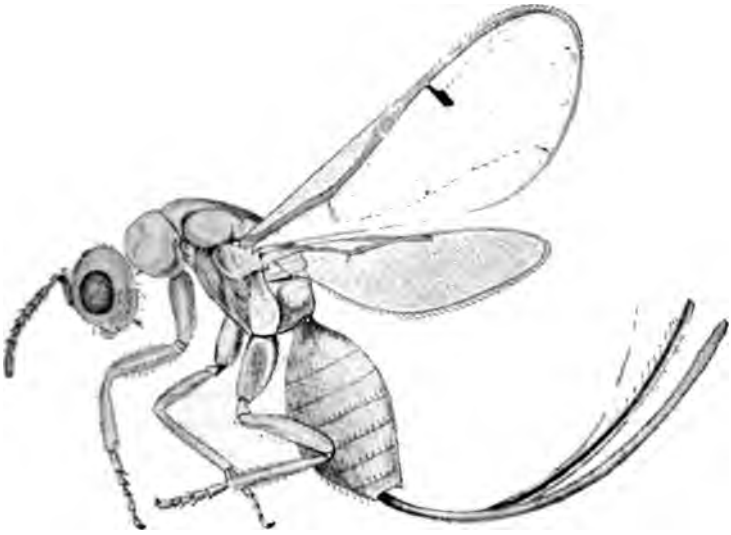
[1] "Is Megastigmus Phytophagic?" by C. V. Riley, *Proc. Ent. Soc.*, Washington, vol. ii., No. 4, 1893.

number of rare and valuable North American conifers, obtained from Oregon, and shipped directly to Copenhagen. From these seeds, kept in glass jars, and exhibited at an Exhibition in 1888, examples of different *Megastigmus* species made their appearance, with no trace of any other insect save a single Dipterous insect from *Abies concolor*. Borriès goes on to say in his letter: "It is worthy of mention that in the preceding year these valuable seeds could not be obtained at all, because, as was reported from Oregon, they 'had been destroyed by a worm.'" Riley received from Borriès *Megastigmus* adults from the following species—*Abies magnifica*, *A. concolor*, *A. amabilis*, *A. grandis*, *Tsuga Hookeriana*, *Abies Mariesii* (a Japanese species). Riley refers the species from the first four trees to probably *Megastigmus pinus*, Parfit, this being a Californian species. Nitsche, too, has chronicled the finding of the larva of a large undescribed *Megastigmus* from the seed of the Californian *Abies amabilis*. In the discussion which followed the reading of Riley's paper, Dr Howard still maintained that the *Megastigmus* larvæ were parasitic on some insect, and that they had only taken to the seed after devouring the host-larvæ, whatever these might be.

Importance of the Question.

The question as to whether *Megastigmus* is parasitic on insects, or is a direct enemy to the plant or tree, is no mere academic one, but is a question of great significance in practical work: for according to the answer given we will either treat *Megastigmus* as a useful ally against a plant and tree enemy, and accordingly protect it, or else recognising it as an enemy, we shall have to wage war against it. With the importance of this question in mind, and apart from the preceding evidence which seems to warrant the view that *Megastigmus spermotrophus is* a direct enemy of the tree, I dissected with great care many of the Douglas fir seeds, and in no dissection did I find a trace of an enemy other than the *Megastigmus*, while all the insects I bred out were, similarly, *Megastigmus*. Mr Crozier's evidence is of great value on this point. Hundreds of *Megastigmus*, and *Megastigmus* alone, have been found by him escaping from the infested Douglas fir seeds.

As we have material, arrangements have been made whereby we hope by direct experiment to trace the life-history of the



a.

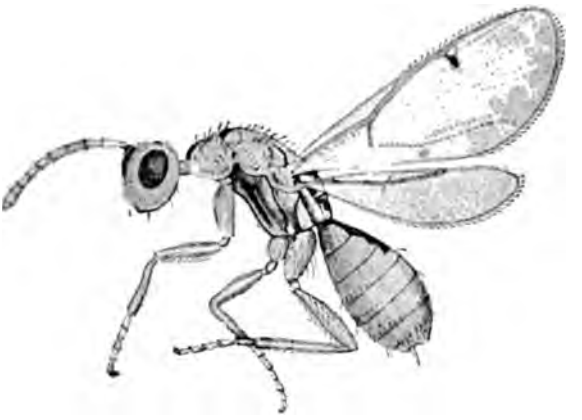
e

c

(*a*) **FEMALE,** GREATLY MAGNIFIED (WACHTL).

(*c*) **LARVA,** NATURAL SIZE AND MAGNIFIED (ORIGINAL).

(*e*) GNAWING MOUTH PARTS OF LARVA, GREATLY MAGNIFIED (ORIGINAL).



b

d

(*b*) MALE, GREATLY MAGNIFIED (WACHTL).

(*d*) ATTACKED SEED OF *PSEUDOTSUGA DOUGLASII* FROM WHICH THE ADULT HAS ISSUED (NATURAL SIZE, AND TWICE MAGNIFIED, ORIGINAL).

species, and the result of this, with Mr Crozier's observations on the cones harvested in 1905 from the Douglas fir and other conifers, we hope to state in a further communication. Meanwhile we may summarise the position thus:—

1. That while the majority of the *Chalcididæ* are parasitic on insects, some are feeders on plants.

2. This phytophagic habit is proved and admitted for the genus *Isosoma* and its immediate allies.

3. That the genus *Megastigmus* contains species parasitic on insects.

4. That it is proved that certain *Megastigmus* larvæ, whether parasitic on insects or not, can at least complete their growth on a seed or plant diet.

5. That the weight of evidence goes to prove that certain *Megastigmus* species are not parasitic on insects, but are feeders on the seeds of plants, and that amongst these, are species very injurious to the seeds of conifers.

6. The finding of parasitic and plant feeding species in the same genus is not impossible. In other animal groups we find forms closely related and yet with different food-habits.

7. The seed-destroying species of *Megastigmus* may or may not once have been parasitic on insects, but if they were once parasitic, they have changed their diet to a vegetable one. Illustrations of such a change are not wanting in other animal groups.

VII. *Some Notes on the Home Timber-Trade in the East of Scotland.*

By ADAM SPIERS, Timber Merchant, Edinburgh.

Like most other industries, the home timber-trade has not escaped the effects of the general depression which has now prevailed for nearly three years, and at present, more especially as regards the uses of hardwood timber, it may be said to be in a state of transition.

Formerly ash of large size and good quality found a ready outlet in the coach-building trade for the construction of the framework of horse carriages, but owing to the advent of the motor-car the demand for timber for this purpose has fallen off very appreciably. In the construction of the motor-car ash, no doubt, finds a use, but this is limited to the lighter parts of the vehicle, the heavy framework being constructed of steel. The introduction of the rubber tyre, too, has had its effect in diminishing the demand for ash for carriage-building, for, owing to the lessened vibration to which the body of the carriage is now subjected as compared with what it was in the days when the iron-tyred wheel held sway, the vehicle has had its average life-time very appreciably prolonged, more especially in the case of hackney carriages in cities where the roadways are paved with stone. In fact, it may be safely stated that there is not more than one horse-carriage built to-day for every ten which were constructed, say, from ten to fifteen years ago. The extension of tramways has, no doubt, caused an increased demand for good clean ash for car-construction; but the home-grown article has been, to a large extent, supplanted for this and many other similar purposes by American ash,[1] which can be readily obtained in long clean scantlings. It must be said, however, that the quality and strength of the American ash which is imported is very inferior to that of ash of home growth, especially in sizes of 12 inches and more on the side, and if a good steady supply of the latter, suitable for this class of work, could be assured, American ash would be much less used than it is at present in this trade.

In recent years coach-wheel makers have had to face a great deal of foreign competition, chiefly American. A large number of light wheels, made principally of hickory and oak, are now imported in a made-up state, and for every three wheel-wrights

[1] *Fraxinus americana.*

who found employment in the light-wheel trade in this part of the country ten to fifteen years ago, it may be safely said that not more than one is employed now. The introduction of the rubber tyre has also had its effect on the light-wheel trade, as it has tended to increase the life-time of the wheel, and owing to this and the more extensive use of American-made wheels, the demand for home-grown timber for light wheels has fallen much below what it was some years ago. Formerly the demand for elm of a size suitable for carriage-wheel naves was a considerable one, and timber was difficult to procure; but owing to the shrinkage in the demand for this size of timber, due chiefly to American competition, it is now not at all an easy matter to find a market for it at remunerative prices. Elm of sufficiently large size for naves and felloes for the heavier kinds of wheels is, however, still in good demand, this being a branch of the wheel-trade into which American competition has not as yet made a very serious inroad.

Oak from 7 to 9 inches in diameter was formerly much in demand for carriage-wheel spokes, but this now finds its chief outlet for colliery and contractors' purposes at comparatively low prices. A large quantity of oak from 9 to 12 inches in diameter is used for spokes for cart and other heavy wheels, and for arms for telegraph and telephone poles, and there is at present some prospect of a good demand for this class of timber for motor-wheel spokes; but for such purposes as these the timber must be clean-grown and of very good quality. The larger sizes of oak timber are much used in waggon-building, but here also a new set of conditions has come into existence which has enabled American competitors to obtain a lodgment. The ordinary railway-waggon is now constructed to carry about double the load it formerly carried, and this has involved the use of longer and heavier timbers for the framework, which are difficult to procure of home growth; hence American oak, which can be easily obtained of sufficient length and weight, and at a comparatively low price, has taken the place of the home-grown article to a large extent. As regards strength and durability, however, the timber of American oak [1] compares very unfavourably with that of the British species.

For many years the boat-building industry afforded a large outlet for the rougher classes of oak and elm, but the advent of the steel-built trawler and drifter has seriously affected this trade; and unless

[1] *Quercus alba.*

in the near future some cheap method of mechanical propulsion can be applied to ordinary fishing-boats, in order to enable them to get quickly to and from the fishing grounds, it is probable that wood boat-building of this sort will become a thing of the past.

Beech is still largely used for tool-making and shuttle-blocks, and wood suitable for these purposes is never difficult to dispose of; but owing to the ever-increasing use of metal, and to the more general use of belt-driven machinery, and the gradual disappearance of the cog-wheel, the demand for beech by millwrights and engineers has now shrunk very considerably. For a number of years a considerable quantity of beech was used in the manufacture of golf-clubs, but this outlet has been steadily decreasing recently owing to the substitution of foreign woods, such as Persimmon[1] and dogwood,[2] for the purpose. For well-grown beech timber 2 feet on the side and over there is still, however, a good demand.

Scots plane under 7 inches in diameter is difficult to market, but for sizes from 7 to 9 inches in diameter there is always a good demand, and at satisfactory prices. For sizes from 9 to 16 inches in diameter it is difficult to find a satisfactory outlet, but larger sizes can be readily disposed of, the prices varying with the quality of the timber and the straightness of the bole.

Owing to the now almost universal use of the metal brake-block for railway and other waggons, such woods as willow, poplar, and lime have lost the position they formerly held in the timber market for this purpose; but, all the same, it is surprising to find that the black Italian poplar is not grown to a greater extent than it is, as on suitable soil it will give a much quicker and heavier return than any of the other broad-leaved trees, and its timber can be put to a great variety of uses.

Birch was formerly much in demand for the manufacture of gunpowder, but the introduction of nitro-glycerine explosives has seriously affected its use for this purpose. Its chief outlet at present is in the brush-making trade, in which large quantities of the timber are used; but a serious drawback to the use of home-grown birch for this purpose is its coarse quality, and in many cases, owing to the inaccessibility of the woods in which it is grown, there is great difficulty in connection with its conveyance to the saw-mill. The timber merchant therefore prefers to

[1] *Diospyros virginiana.*

[2] *Cornus alternifolia* (probably).

have his wants supplied from Sweden and Russia, whence any quantity of clean round poles suitable for his purposes can be obtained at a price which is less than he has to pay for home-grown material.

Of coniferous timbers, larch is by far the most important in the home timber-trade. It is used for a great variety of purposes, and there is really no other timber which can be substituted for it for many of these uses. Every year it seems to be getting more and more difficult to procure supplies of this timber, and prices are always good. For Scots pine of suitable size for railway sleepers there is always a good steady demand; but for smaller sizes of Scots pine, the principal outlet for which is for mining purposes, the prices have been low for the past two years, though there are at present signs of improvement in this direction. Spruce is chiefly used for mining purposes, but clean-grown stuff is also used in the manufacture of packing-boxes, though the foreign article competes keenly with it in its use for this purpose. Silver fir in this part of the country occurs in such small quantity that it may be left out of account, and such as does occur is coarse and only fitted for such purposes as rough spruce is put to.

Though the home timber-trade has been seriously depressed for some time, there are not wanting at present some signs of returning prosperity. At the same time it behoves us to look ahead and if possible discover new outlets for our produce, and to stem, as far as we can, the tide of foreign competition, especially in hardwood timbers. No foreign hardwood timber of the same kind can excel our best home-grown samples in strength and durability; but unless long, straight, clean-grown boles from which scantlings of sufficient length and weight to meet the demand which has recently sprung up for them can be procured, foreign competition will continue to make headway. Short-boled, coarse, heavy-topped trees are not what we want nowadays. Such trees cost much more to fell than those of clean growth, and the clearing-up of the brash is a serious item; moreover, the price which can be given for the timber is, owing to its being unsaleable for any but the coarser purposes, a low one. What is wanted is long, clean-grown timber of good quality. Such timber will pay the grower, timber merchant and consumer alike much better than coarse stuff, so much of which is often put on the market in large quantities, causing serious depreciation in prices.

VIII. *Notes on the Rate of Growth of Mature Timber-Crops in Eastern Perthshire.* By the HON. EDITOR.

The details given in the following Table refer to measurements made on good average stems, in timber-crops of about 90 years of age, growing on soil of good quality and varying from loam to stiff clay, and under climatic conditions that are mild, equable, and fairly dry (average rainfall 27 inches, most of which falls during summer and autumn).

The woods are mostly coniferous, and consist chiefly of Scots pine, still largely interspersed with larch and spruce, although there was probably a greater proportion of larch formerly. So far as is known, the past treatment of the woods was the common enough process of "thinning out" the best poles "to let the others come up," and probably the larch was cut out to the largest extent, as being most in demand and best paid.

Numerous stumps of trees show that up to about 65 or 70 years of age the rate of growth was decidedly good, while since then it has (as the measurements below indicate) in many cases been very poor indeed. Regarded as crops of timber the woods are all fully mature, and in some portions over-mature, although the stems are still small in girth for their age—owing, most probably, to the past method of treatment as regards "thinning." Even in the best-wooded portions the crops are thin and irregular. In most parts much of the best larch has been cut out, so that what were probably only the inferior poles of this species have been left, many of which are now unsound in the heart, especially where the soil is moist.

The measurements were made by means of a Pressler's borer or increment-gauge, and with the following results, compartment by compartment:—

Kind of Tree.	Girth at breast-height, 4½ feet (over bark).	Number of Annual Rings in last inch of Radius=6½ ins. of girth (without bark).	Kind of Tree.	Girth at breast-height, 4½ feet (over bark).	Number of Annual Rings in last inch of Radius=6½ ins. of girth (without bark).
	ft. ins.			ft. ins.	
Pine[1]	4 2	12	Pine	4 0	19
Larch	2 11	17	Do.	3 9	22
Oak	3 8	11	Do.	3 6	12
Do.	3 7	9	Larch	4 4	6
			Do.	4 0	7
Pine	4 3	14	Do.	3 6	12
Do.	4 3	9			
Do.	3 2	14			
Larch	3 10	13	Pine	5 7	10
Do.	3 10	15	Do.	4 10	11
Spruce	4 3	12	Larch	4 3	11

[1] All the pine are Scots pine.

Kind of Tree.	Girth at breast-height, 4½ feet (over bark).	Number of Annual Rings in last inch of Radius=6½ ins. of girth (without bark).
	ft. ins.	
Old Pine (120 to 130 years)	6 4	17
Pine	3 9	13
Do.	3 7	12
Do.	3 6	14
Do.	3 3	11
Larch	4 0	9
Do.	3 9	11
Oak	6 5	12
Do.	6 3	11
Ash	5 0	12
Pine (120 to 130 years)	5 4	25
Do.	5 1	16
Do.	4 8	35
Larch	5 10	8
Do.	5 3	11
Sycamore	4 6	10
Beech (120 to 130 years)	5 1	13
Do.	4 8	15
Do.	4 6	14
Oak (90 years)	5 4	13
Do.	4 10	14
Do.	4 9	21
Silver fir (90 years)	5 7	10
Beech (160 to 180 years)	6 10	14
Beech	5 3	12
Do.	3 8	15
Pine	4 3	12
Do.	4 2	10
Spruce	4 10	16
Do.	4 5	15
Larch	5 0	8
Do.	4 5	10
Do.	3 10	12

Kind of Tree.	Girth at breast-height, 4½ feet (over bark).	Number of Annual Rings in last inch of Radius=6½ ins. of girth (without bark).
	ft. ins.	
Sycamore	4 5	10
Do.	4 1	11
Do.	3 8	12
Do.	4 11	11
Oak	3 6	19
Do.	2 10	18
Do.	2 7	18
Elm	5 7	12
Do.	4 11	10
Ash	3 10	10
Do.	3 5	12
Do.	3 1	8
Larch	3 11	21
Pine	3 8	16
Beech	4 6	13
Larch	5 6	14
Do.	5 2	11
Do.	4 8	12
Do.	4 4	10
Oak	4 11	14
Do.	4 0	10
Beech	5 10	11
Do.	4 5	12
Sycamore	4 8	11
Do.	4 3	11
Ash	5 7	14
Do.	3 3	15
Do.	3 2	16
Oak	6 2	12
Do.	5 1	11
Do	4 6	15
Larch	7 5	8
Do.	6 7	11
Do.	5 4	10
Larch	3 5	21
Do.	3 5	20
Do.	3 3	23
Do.	3 1	16
Do.	3 0	28
Do	3 0	21
Oak	5 2	11
Do.	4 3	18
Do.	4 3	19
Do.	4 2	15

The crops in which these measurements were made were at the time (1900) so thin, that further thinning would hardly be likely to stimulate their rate of growth to any perceptible amount. And, of course, this means that the trees will therefore take at least as long to increase by the next 6 inches in girth, measured at breast-height (1 inch radius = $6\frac{2}{7}$ inches girth), as the above measurements prove them to have taken for their last increase of 6 inches. The reader can easily tabulate for himself, should he desire to do so, the rate of growth for each individual kind of tree, according to the quality of the soil and situation in the various compartments.

IX. *Note on "The Railway Fires Act, 1905."*

By the HON. EDITOR.

In paragraph 31 of the Report of the Departmental Committee on Forestry, 1902, it was stated that "some adequate security against the raising of fires by sparks from railway-engines seems equally feasible and desirable. It is not necessary to dwell further upon this subject than to urge the desirability of some such Bill becoming law at the earliest opportunity."

This recommendation has been given effect to by the introduction of a Bill on 3rd March 1905, providing for compensation for damage to crops, which became an Act on 4th August 1905, and is to be known by the short title of "The Railway Fires Act, 1905," although it does not come into operation until 1st January 1908.

It is a short Act of five Sections, which may be summarised as follows:—

SECTION 1.—Railway companies are liable to make good the damage to crops caused by sparks or cinders from their engines, notwithstanding "the fact that the engine was used under statutory powers"; but "this Section shall not apply in the case of any action for damage unless the claim . . . does not exceed £100."

SECTION 2.—A railway company may enter land to extinguish and arrest the spread of fire caused by sparks or cinders, and may enter plantations, woods, etc., "and cut down and clear away any undergrowth, and take any other precautions reasonably necessary for the purpose; but they shall not, without the consent of the owner, . . . cut down or injure any trees, bushes, or shrubs. A railway exercising powers under this Section shall pay full compensation to any person injuriously affected by the exercise of these powers, including compensation in respect of amenity."

SECTION 3.—"This Act shall not apply in the case of any action for damage by fire brought against any railway company unless notice of claim and particulars of damage, in writing, shall have been sent to the said railway company within 7 days of the occurrence of the damage as regards the notice of claim, and within 14 days as regards the particulars of damage."

SECTION 4.—For the purposes of this Act, "agricultural land" includes land used for "plantations and woods, and . . . fences on such land, but does not include any moorland or buildings"; and "agricultural crops" include "any crops on agricultural land, whether growing or severed, which are not led or stacked," while "the expression railway" includes any light railway and any tramway worked by steam power."

SECTION 5.—"This Act shall come into operation on 1st January 1908. . . ."

While farmers and owners of woodlands must be thankful to have an end thus put to the exemption claimed, under a judicial decision given in 1894, to the non-liability of railway companies for damage caused by engine-sparks (though owners of traction-engines on roads have always been held liable for similar damage), the Act hardly seems to meet the necessities of the case with regard to railway-lines passing through large woods of coniferous trees growing on dry soil. In plantations of this description, fires might very easily do vastly greater damage than would be fairly compensated by £100; and the Act seems, therefore, to be unsatisfactory in not arranging for reasonable steps being taken under it, conjointly by the landowner and the railway company in such cases, through the medium of the Board of Agriculture.

The means of obtaining some such security could be easily provided by an additional clause to Section 2, such as the following:—

In the case of extensive woods or plantations, the owner of the same may submit to the Board of Agriculture proposals for their fire-protection, together with an estimate of the cost of carrying out the proposed protective measures along the railway line; and on approving the proposals as reasonable and proper precautions, the Board of Agriculture may give sanction for the carrying out of such measures to whatever extent may be considered necessary, and may pass orders that the railway company shall contribute not more than one-half of the estimated or of the actual expenditure thereon, whichever may be the less in amount.

This seems only a reasonable precaution, because there is no fear whatever that any landowner will go to unnecessary expense in fire-protective works of this description merely because he may possibly force the railway company to contribute thereto one-half of the estimated or the actual expense, whichever may, on the completion of the work, prove to be the less in amount. It would be much the same in effect as the customary power in Scotland with regard to the sharing of the cost of march-fencing and repairs to boundary fences between any two adjoining properties. And it would just be as little liable to abuse, more particularly if the Board of Agriculture—which ought soon to be further enlarged into the "Board of Agriculture, Fisheries, and Forestry," with an Assistant Secretary in charge of a special Forestry branch—had such powers as above indicated for amending, sanctioning, and passing orders on the estimates for fire-protection submitted to it.

In its phraseology the Act seems clumsy. That woods and plantations should be included in "agricultural land," and timber or other woodland crops in "agricultural crops," is a striking misuse of the English language. It would have surely been simpler and far preferable to have used the term *land under cultivation*, which would include all land used for the purposes of agriculture, grazing, market- and nursery-gardens, woods and plantations, etc., while *cultivated crops* would, of course, mean *all kinds of produce grown on land under cultivation.*

Etymologically and by customary use the words *agriculture* and *agricultural* have a definite meaning in the English language, and this new Act now gives to these terms—though only in so far as concerns this special Act—a judicial meaning absolutely at variance with their true meaning. But that is a mere verbal blemish, which can have no influence on the working of the Act. What is, perhaps, much more important is that this new and wrong use of the word *agricultural* is entirely at variance with the sense in which the term is used in other Acts, as, for example, in that giving relief to agriculture as regards assessment to local rates. In proof of this, one need only call attention to what was said in paragraph 28 of the report by the Departmental Committee on Forestry, 1902.

X. *On some Japanese and North American Trees suitable for growing in British Woodlands.*[1] By H. J. ELWES, F.R.S., Colesborne, Cheltenham, Gloucestershire.

Having spent more than five months of last year in studying the forest trees and forest conditions of Japan and parts of North America, it has occurred to me that this Society might be interested to learn something about several kinds of trees worthy of being given a prominent place in the forestry of Great Britain. Although we know a good deal about them in a young state, I have long been doubtful of the wisdom of planting Japanese larch and Douglas fir as forest trees on a large scale, except under conditions rare in this country; and before embarking largely on what must for many years remain a doubtful speculation, it is of importance to know the conditions of soil and climate under which these trees grow naturally. I spent only seven weeks in Japan—far too short a time to enable me to see all that I should have wished to see; but the Japanese Government were good enough to send two of their forest officials, Messrs Shirasawa and Mochizuki, both of whom had studied in Germany, to accompany me to the most interesting forests of Northern and Central Japan, so that I was able to accomplish a great deal that I could not have done without their assistance. I cannot sufficiently express my gratitude to these gentlemen, and to the Japanese officials in general, for the great kindness they showed me everywhere; and I formed a very high opinion of the skill and ability with which the Japanese forests, both public and private, are generally managed.

Though I had previously studied the fauna and flora of Japan, and read important works on the subject, especially Professor Sargent's admirable book on the *Forest Flora of Japan*, I was astonished to find how different the forests were from what I had expected, and how much more the summer climate and vegetation of Japan resembled those of some parts of the Himalaya than anything I had seen in Europe, Northern Asia, or the United States. Without going into details, I will

[1] Lecture delivered at the Annual General Meeting of the Society on 10th February 1905. Those parts of Mr Elwes' lecture have been omitted which were explanatory of the photographic pictures shown upon the screen, as the illustrations cannot be reproduced here.—HON. ED.

endeavour to make clear how greatly the soil and climate differ from those of Great Britain, and how few trees there are in Japan from which we can expect good economic results here. The Japanese larch, so highly esteemed in Britain on account of its rapid growth up to 30 to 40 years and its apparent resistance to disease, grows in the mountains of Central Japan, though only on volcanic soil, so far as I saw. It sometimes grows in pure or nearly pure woods, but is often scattered in mixed woods of deciduous and coniferous trees, and it attains its best development at an elevation of 4000 to 6000 feet. From May to October the climate is there warmer and moister than in any part of Great Britain,[1] while the winter is long, cold, and dry; hence the tree is not exposed during its growing-season to the frequent changes which it must endure here, and it gets a longer and more complete rest in winter. Notwithstanding these very favourable conditions, it never attains the height or girth of the European or the Siberian larch, or of the western larch of North America, a much finer tree from every point of view, except as to rapidity of growth. The largest trees I saw did not exceed 80 feet in height and 12 feet in girth, when growing amongst deciduous trees; and in pure forest 5 to 6 feet in girth was about the average size of the full-grown tree under the best conditions. I do not think it is nearly such a long-lived tree as the common larch, and though it does not in Japan usually have such a wide-branching habit as it assumes in this country, I should look on it as a forest tree inferior to our larch in every point except its power of resisting disease, and only likely to attain considerable size on better land than the

[1] Mr Elwes seems to be under some misconception as to the relative degree of moistness of the climate of the United Kingdom (see also the *Transactions*, vol. xviii., 1905, p. 145). The climate throughout the United Kingdom is certainly moist rather than dry; and the maximum rainfall recorded for Europe is said to be the 244 inches measured during 1872 at the Styhead Pass (1077 feet in elevation) in Cumberland. The whole of the west of Scotland, as well as the west of Ireland, possesses a very damp climate; and it is, doubtless, deficiency in summer warmth and in intensity of sunlight, far more than want of humidity, which must be the main regulating factor to which Mr Elwes here refers. In support of this statement, one need only quote what was said by Admiral Sir W. J. L. Wharton, F.R.S., in his address as President of Section E, *Geography*, at the meeting of the British Association (in Cape Town) on 16th August 1905: "*Take the United Kingdom, notoriously warm and damp for its position in latitude; this is mainly due to the prevalence of westerly winds.*"—HON. ED.

European larch requires to bring it to perfection.[1] The timber is very similar to that of our larch, and is found so useful in Japan for telegraph poles, railway sleepers, ship- and house-building, that it is being planted very largely in certain districts, especially in the central parts of the main island, and in the cultivated parts of the northern island, usually known as Yezo, but always called Hokkaido by the Japanese. I have raised this tree at home from seed produced in Scotland, England, and Japan, and have found the home-grown seed produce the best and strongest plants on poor limestone soil.

Another Japanese larch, *Larix kurilensis*, H. Mayr (syn. *Larix dahurica*, Turcz.),[2] grows in the very cold, foggy, and damp climate of the Kurile Islands, and in the island of Saghalien, where it is reported to attain a much greater size than in the Kuriles; but though this tree has been introduced, it is too little known as yet to judge of its fitness for general cultivation here. It certainly seems at least as well worth a trial as *Larix leptolepis*, especially in the west and north-west of Scotland, Ireland, and Wales.

None of the other Japanese conifers, except, perhaps, *Cryptomeria japonica*, seems to have any special qualities recommending them to Scottish foresters. For though there are splendid forests of spruce and fir in Hokkaido which are now being largely worked for timber, and though *Cupressus obtusa* and *Thuya dolobrata* of the central island are beautiful, ornamental trees, producing a large amount of valuable timber in Japan, they do not grow fast enough, and they require so much better conditions than our European conifers, that they cannot be looked upon as useful forest trees in Great Britain. With regard to the *Cryptomeria*, however, I am inclined to think that if seed were procured from the north, where I saw magnificent forests in the province of Akita, it might well be tried as a forest tree in the warmer parts of England and in the south-west of Scotland and Ireland. It ripens seed freely here,

[1] See editorial footnote to page 149 of the *Transactions*, vol. xviii., 1905. It is very questionable if the Japanese larch will long continue comparatively immune from the insect attacks and fungous diseases to which the common larch is subject; and in the event of this comparative immunity (which has hitherto obtained) coming to an end, the Japanese species can then have no claim whatever to superiority over the European species, as its timber is certainly not likely to be so good and durable.—HON. ED.

[2] According to Kent (Veitch's *Manual of the Coniferæ*, 2nd ed., p. 391), "Dr Regel distinguished three forms of *Larix dahurica:* (1) *typica;* (2) *prostrata;* (3) *japonica;* the last-named probably the *L. kurilensis* of Mayr."—HON. ED.

is easy to raise from seed, grows faster when young than almost any tree I know except larch and *Cupressus macrocarpa*, grows in close canopy, and produces valuable and beautiful timber. It wants good soil, no doubt, shelter from dry, cold winds, and plenty of moisture during the growing-season; but though it has proved hardy in most parts of England, we have never, so far as I know, had seed from that part of Japan where the conditions are most like those of Great Britain, and from which I should expect the best results.

Of the deciduous trees of Japan, the best for timber is *Zelkowa Keaki*, which grows easily from seed in England, and seems very hardy; but it does not ripen its wood when young, and it has a tendency to make many branches, a habit which, unless it be grown in close canopy in a plantation on deep, rich soil, will probably render it unsuitable for producing timber in this country. *Cercidiphyllum japonicum*, which grows to a great size in Hokkaido, and produces fine timber, *Acanthopanax ricinifolium*, and *Magnolia hypoleuca* are all perfectly hardy as regards winter cold; but the first is not hardy in spring, and the others, like most of the Japanese forest trees, require a warm and wet summer, and deeper, moister soil than they can have here. None of the Japanese oaks, of which there are many, as yet seem to be valuable as forest trees in Europe, and *Æsculus turbinata*, though it is often very ornamental, is not equal in beauty to our horse-chestnut. Neither of the Japanese walnuts attains any great size even in Japan; and out of the long list of Japanese trees, nearly one hundred in all, which may prove hardy in England, not one seems likely to add to our somewhat scanty list of valuable timber-trees, except perhaps *Betula Maximowiczii*, the largest of all the birches, and a lime which is probably *Tilia cordata* var. *japonica*.

I have not alluded to the great variety of species which make the Japanese forests so interesting to a botanist: no other temperate country has so many growing together in the same forest. In the Kisogawa district of Central Japan I made, with the help of the local forester, a list of about eighty-five species, including twenty-five conifers, which are found growing spontaneously in an area of about 400,000 acres. It includes five pines, three or four silver firs, two or three spruces, hemlock, *Thuya*, *Cupressus*, *Larix*, yew, juniper, five birches, four alders, three hornbeams, five or six oaks, three or four maples, elm, lime, two magnolias, two chestnuts, poplar, two ash, and a number of genera unknown in Europe; but few, if any, of these trees

grow gregariously, and the forest is so dense in places where it has not been touched by woodcutters, that it is often hard to identify the species. A marked characteristic of these forests is the dense growth of dwarfish, creeping bamboo which covers the ground, and the number of climbing plants. The latter grow to the tops of many of the large trees, and are used for ropes, like the rattans of the Himalaya and the tropics.

The forests of the Pacific coast of North America are probably the only ones in the temperate regions of the world which contain a great reserve of large timber suitable for export; and of the trees which constitute this reserve, the Douglas fir is by far the most important. Though not equalling *Sequoia gigantea* in girth, it probably surpasses every other tree, except perhaps *S. sempervirens*, in height, trees of 250 to 300 feet being common in the forests of British Columbia and Washington. Here the climate is moist, and the soil often very deep and good, so that the trees have advantages which they cannot have in Scotland. The timber which is cut for export comes from selected trees of not less than 200 years old, and often much more, and the rate of growth depends on the density of the crop when young. I doubt whether we can hope to produce timber equal to it in size or quality, because we so rarely find soil good enough to keep the trees growing sufficiently densely to clean their trunks; and even if such places be planted, really fine timber cannot be expected in less than 150 to 200 years,[1] and this is too long a period for most planters in Europe to wait for a return. What the value of the thinnings may be is, as yet, somewhat uncertain; but from what I have seen in the best plantations in Scotland and England, I doubt whether this item would equal in value that obtainable from larch thinnings off an equal area of similar land. The different varieties of Douglas fir seem to be but little understood in Britain at present. It is supposed that there are two well-marked forms, which are sold as "Oregon" and "Colorado" respectively. The latter we know to be a much slower-growing tree than the Pacific coast form, though hardier.

[1] A rotation of 150 to 200 years for conifers in Britain seems quite out of the question. From 40 or 50 to 60 or 70 years will probably prove the usual limits for growing such timber-crops on business principles. And as the celebrated plantation of Douglas fir (at Taymount, near Scone) was worth nearly £200 an acre at 40 years of age (1900), the wood-merchant who then offered 9d. a cubic foot for the whole crop could hardly have thought the timber of inferior quality.—HON. ED.

Professor Sargent says that the form found in the dry interior of the Continent rarely exceeds 80 to 100 feet high; and in Montana, where the climate is somewhat intermediate between that of the wet warm coast and the very dry continental climate of Colorado, I never saw any tree of great size, nor at all approaching in this respect the *Larix occidentalis*, which grows with it. Probably it will be wise to use home-grown seed as far as possible; but if that cannot be got in sufficient quantity, I should prefer seed gathered in British Columbia at 2000 to 3000 feet elevation, and would never plant trees from Colorado seed except for ornamental purposes.

A tree which seems likely to equal, if not to surpass, the Douglas fir as a timber-producer here is *Thuya gigantea*, which grows associated with the Douglas fir on the Pacific coast from Oregon northwards, and is a most thriving tree in England wherever I have seen it. This tree is as easy to raise from home-grown seed as the larch, easy to transplant at almost any season between August and May (I have done it successfully in quantity in both those months), much less particular about soil and situation than Douglas fir, bears close canopy as well or better, produces equally good and more durable timber, and is, so far as I have seen, rarely subject to any insect attack or fungous disease. I have planted it largely, and after studying it in its native country shall continue to do so, though we have yet much to learn about it.[1]

Another tree which at present seems neglected by forest planters is *Cupressus nootkatensis*, also known as *Thuyopsis borealis*. From what I have seen, both in England and in America, I am convinced that if supplies of seed were got (as they easily might be, though nearly all the trees now raised at home are from cuttings), this tree, in spite of its growth being much slower than that of *Thuya gigantea*, should be planted on land too shallow and dry for the latter or for Douglas fir. Its timber, though not yet cut for export, is considered by competent authorities superior to that of any other North American conifer for fine inside work, and it is also extremely durable. It grows higher on the mountains and farther north than Douglas fir or *Thuya;* but

[1] I have only seen *Thuya* growing (as a woodland tree) in admixture with (1) Douglas fir, and (2) with larch, Scots pine, and spruce. In no case did it hold its own with any of these other trees as to rate of growth in height; and it was almost *completely suppressed* by the Douglas fir at about 17 to 18 years of age. One cannot, however, deduce any sound general opinion merely from a few of such isolated cases.—HON. ED.

it does not usually attain a great size, though I measured a tree over 20 feet in girth on Mount Tacoma. It is known as "Yellow or Sitka cedar," whilst *Thuya gigantea* is called "Red cedar," and Douglas fir "Yellow or Red fir." The latter is also known in the timber trade as "Oregon fir or Oregon pine."

Space does not permit me to deal with many other conifers of the Pacific coast, which are mostly known as ornamental trees, and are none of them likely to take a place in economic planting; though Sitka spruce (*Picea sitchensis*) might be tried on a small scale, in a dense thicket, in wet hollows unfit for common spruce. It has already been largely planted on the Durris estate. It grows to a great size on the Pacific coast, and its wood is now found more suitable for naval oars than that of any other tree, because it can be obtained in a young state quite free from knots. I must not, however, omit to mention the western larch (*Larix occidentalis*). It is by far the largest of all the larches, attaining 200 feet commonly in North-western Montana, and reaching 250 feet under favourable conditions. It is a mountain tree, thriving in a long cold winter and a warm short summer; but it has the defect of being a much slower grower than the common or the Japanese larch. Probably it would here succeed best on the mountains of northern and eastern Scotland at elevations where the common larch does not grow well. But it may require more summer heat; and, like so many other trees from a similar climate, it may on that account prove unsuccessful from an economic point of view. Though this tree did not entirely escape the notice of Douglas and of other early seed-collectors in America, it was only introduced into a few Botanic Gardens and private collections. At great trouble and expense I secured a small quantity of seed last year, and I am pleased to learn, from some of those to whom I sent it for trial in Scotland, that it has germinated and grown well. Its timber is superior in grain, colour, and strength to that of European larch grown in Britain, though not, perhaps, to the timber of alpine and North Russian larch.[1] A door made from it, which I brought home, is really a beautiful specimen of woodwork; and if the cost of transport, from the limited area in which the tree is found, be not excessive, there should be a large demand for this fine wood for joinery.

[1] These are, however, two different species—the alpine larch (*L. europæa*) and the Russian or Siberian larch (*L. sibirica*).—HON. ED.

XI. *Working-Plan for the Alice Holt Forest.*[1] By Dr W. Schlich, assisted in the Field-Work by Mr W. F. Perree.

PART I.—DESCRIPTION OF ALICE HOLT WOODS.

1. Situation and Proprietorship.

The Alice Holt Woods are situated at the eastern extremity of Hampshire, bordering on the county of Surrey. They form part of the ancient Crown property. By the Act passed in the year 1812 (52 Geo. III. cap. 72), called "An Act for the Better Cultivation of Navy Timber in the Forest of Alice Holt," it was provided that the deer in the forest should be removed, and power was given to the Crown to enclose, out of the waste lands of the forest, not exceeding 1600 acres from such parts as should be found most convenient to be enclosed, and to be best adapted to the growth of timber, such inclosures to be freed from all manner of rights and to be made a nursery, or nurseries, for timber only, and to be accepted by the Crown as an adequate compensation for all rights of soil or other right over the remaining 827 acres of the waste lands of the forest, which last-mentioned lands were to become the property of the persons having rights of common over the forest. And it was provided that, after the passing of the Act, no rabbits should be kept on any part of the said forest on any account or pretence whatever.

The inclosures made by the Crown under that Act extended to exactly 1600 acres. There were also 296 acres of land which were the freehold of the Crown before the Act was passed, part of which was occupied with lodges; and various small parcels allotted to the commoners have been purchased by the Crown.

The area of the forest at the present time amounts to 1884 acres, divided into the following blocks:—(1) Glenbervie Inclosure; (2) Willow's Green Inclosure; (3) Abbott's Wood Inclosure; (4) Holt Pound Inclosure; (5) Goose Green Inclosure; (6) Straits Inclosure; (7) Lodge Inclosure.

The woods are surrounded by agricultural lands, mostly belonging to private proprietors, and a strip of private land runs through the centre, dividing Glenbervie, Willow's Green, and Abbott's Wood on the east from Holt Pound, Lodge Inclosure, Goose Green, and Straits on the west. There is a residence

[1] Reproduced by kind permission of the Comptroller of H.M. Stationery Office.

with a keeper's house in Lodge Inclosure let on lease, a keeper's lodge in Abbott's Wood, the foreman's house in Little Goose Green, and a keeper's lodge in Glenbervie.

The woods are under the control of the Commissioners of His Majesty's Woods and Forests. The officer in charge is the Deputy-Surveyor of the New Forest, who has a foreman living on the spot as his executive official. The foreman is assisted by a woodman.

The lessee of Alice Holt Lodge enjoys the shooting over the Lodge Inclosure, Holt Pound, Willow's Green, and Glenbervie. The shooting over the other woods is leased to the War Department, with the right to use the woods for military exercises.

2. Configuration of Ground, Geological Formation Soil, and Climate.

The northern part of the area forms a plateau with a maximum elevation above sea-level of about 400 feet. This elevation is fairly maintained on going south until Abbott's Wood is reached. For the rest, the land slopes away on the east, west, and south to an elevation of about 230 feet. Local depressions have been formed by watercourses, the latter generally carrying very limited quantities of water. The woods are situated on the Gault, hence the soil is generally of a clayey nature. There are, however, exceptions, such as the north-east portion of Glenbervie, which has a more sandy soil. Another strip of sandy soil runs east and west, commencing in Willow's Green and passing into Goose Green. With these and other exceptions of small extent, the soil is clay, with little or no accumulation of humus. The soil covering consists chiefly of brambles, bracken, other ferns, and weeds. A more detailed account of the soil will be found in the Appendix.

The climate is that of the south of England, that is to say, comparatively mild and damp, with a rainfall of about 26 inches, fairly distributed over the several parts of the year. Spring is the driest season.

3. Description of Forest Growth.

There is evidence to show that the Alice Holt Woods were stocked with oak for centuries past. It is not necessary, on this occasion, to go back beyond the last twenty-five years of the eighteenth century. During that period, and probably during

the beginning of the nineteenth century, considerable quantities of oak timber were cut for the navy; so that about the year 1810 little big timber was left. At that time it was resolved to replant a considerable area of the Crown lands, so as to create a reserve of oak timber for the use of the navy. Under this movement the Alice Holt Woods were planted with oak between the years 1815 and 1825, the only exception being, apparently, the western half of Straits Inclosure, which seems to be some years younger than the rest of the oak-woods. In the course of time the plantations were periodically thinned to such an extent that they are now too thinly stocked. The development of the oak has been very uneven. In some parts the trees have reached a fair size and shape, showing a height of 60 feet and upwards, in others the development has been so poor that the height may be put down at from 30 to 40 feet. There is an intermediate class, the mean height of which varies, according to locality, between 40 and 60 feet.

Certain areas of the lowest class have already been converted into coniferous woods. There is also a limited area of coppice.

By classifying the woods in accordance with these remarks, the following Table is obtained:—

Classification of Woods.

Name of Inclosure.	Oak-Woods.				Coppice-Woods.	New Plantations.	Grand Total.
	1st class. Mean height, 60 feet and over.	2nd class. Mean height, 40 to 60 feet.	3rd class. Mean height, under 40 feet.	Total.			
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1. Glenbervie, . .	...	194	155	349	...	14	363
2. Willow's Green, .	...	106	75	181	...	17	198
3. Abbott's Wood, .	10	167	35	212	...	16	228
4. Holt Pound, . .	2	217	21	240	1	...	241
5. Goose Green, . .	49	167	7	223	...	...	223
6. Straits, ...	236	..	...	236	...	...	236
Total, . .	297	851	293	1,441	1	47	1,489
7. Lodge Inclosure, .	18	295	38	351	30	14	395
Grand Total, . .	315	1,146	331	1,792	31	61	1,884

(a) *The Oak-Woods.*

It will be observed that the oak-woods occupy 95 per cent., and the coppice and new plantations together 5 per cent. of the area. As to the several classes of oak-woods, the distribution is as follows:—

Of the total oak area—

	Per cent.
The first-class woods occupy . .	18
The second-class woods occupy . .	64
The third-class woods occupy . .	18
Total, .	100

It is, of course, of importance to know how much material now stands on the oak areas. In order to determine this accurately, it would have been necessary to make extensive measurements involving much time and expense. Hence it was considered sufficient to restrict the measurements to 11 sample plots of one acre each, of which three are situated in first-class oak, seven in second-class oak, and one in third-class oak. There are also the results of actual cuttings on 23 acres of third-class oak, and previous estimates made by the Hon. G. Lascelles.

The results of the measurements are given in the subjoined Table:—

Table showing the Result of Measurements on Sample Areas.

Name of Inclosure and No. of Sample Plot.	Number of Trees per acre.	Mean height in feet.	Mean diameter of Trees at height of chest in inches.	Volume in solid Cubic Feet according to quarter-girth measurement.
First-class Oak-Woods.				
1. Straits, ...	67	60	15	1,514
2. ,, ...	60	60	15	1,779
3. Lodge Inclosure, .	63	63	16	2,169
Average, . . .	63	61	15	1,821
Of this quantity Timber = 60 per cent. =				1,093
Of this quantity Cordwood = 40 per cent. =				728 = about 9 cords stacked.
Second-class Oak-Woods.				
4. Glenbervie, ...	92	50	12	1,305
5. Willow's Green, . .	79	51	13	1,358
6. Abbott's Inclosure, .	62	56	14	1,420
7. Holt Wood, . . .	90	51	12	1,257
8. ,, ,, . . .	76	52	13	1,233
9. Goose Green, . . .	77	51	13	1,391
10. Lodge Inclosure, . .	100	50	12	1,264
Average, . . .	82	52	13	1,318
Of this quantity Timber = 50 per cent. =				725
Of this quantity Cordwood = 45 per cent. =				593 = about 7½ cords stacked.
Third-class Oak-Woods.				
11. Glenbervie, . . .	180	37	8	702
Of this quantity Timber = 50 per cent. =				351
Of this quantity Cordwood = 50 per cent. =				351 = about 4½ cords stacked.

It will be useful to see how these estimates agree with those made by the Hon. G. Lascelles. The latter estimated the quantity of timber as follows:—

First class Oak—

In Abbott's Wood, .	. 840	cubic feet per acre.
In Goose Green, .	. 1100	,, ,,
In Straits, . .	. 1020	,, ,,
In Lodge Inclosure,	. 935	,, ,,
Average,	. 974	cubic feet per acre.

Second-class Oak—

In Glenbervie, .	. 600	cubic feet per acre.

Third-class Oak—

In Glenbervie, . . 420 cubic feet per acre.

During the years 1900 to 1902 the cuttings of third-class oak extended over 23 acres, and the average results were:—

Timber, . . . 402 cubic feet per acre.
Cordwood, . . . 5·3 cords per acre.

It appears, therefore, that the following figures can be applied, on an average, throughout the woods:—

	Timber per acre.	Cords per acre.
In the first-class oak-woods, . .	1000	10
In the second-class oak-woods, .	700	7
In the third-class oak-woods, . .	400	5

Utilising these data, the stock now standing in the forests has been calculated as follows:—

Stock of Timber and Cordwood standing in the Alice Holt Oak-Woods.

Name of Inclosure.	Oak Timber, cubic feet, quarter-girth measurement.				Cords, number, of 128 cubic fee stacked.			
	1st class.	2nd class.	3rd class.	Total.	1st class.	2nd class.	3rd class.	Tota
Glenbervie, . . .	...	135,800	62,000	197,800	...	1,358	775	2,1
Willow's Green, .	...	74,200	30,000	104,200	...	742	375	1,1
Abbott's Wood, .	10,000	116,900	14,000	140,900	100	1,169	175	1,4
Holt Pound, . .	2,000	151,900	8,400	162,300	20	1,519	105	1,6
Goose Green, . .	49,000	116,900	2,800	168,700	490	1,169	35	1,6
Straits, ...	236,000	...	...	236,000	2,360	...	...	2,3
Total, . .	297,000	595,700	117,200	1,009,900	2,970	5,957	1,465	10,3
Lodge Inclosure, .	18,000	206,500	15,200	239,700	180	2,065	190	2,4
Grand Total, .	315,000	802,200	132,400	1,249,600	3,150	8,022	1,655	12,8

Assuming that the value of the oak timber now standing on the area is £0, 1s. 3d. net per cubic foot all round, and of the

cords £0, 18s. 0d. net each, the value of the stock of oak would be as follows:—

Oak timber, . . .	£78,100
Cordwood, . . .	11,544
Oak bark, say £3 net per acre, .	5,376
Total value, .	£95,020

This represents an average annual value production of 12s. 6d. per acre.

It appears that there is no record available of the quantity of produce removed in the thinnings, but the receipts from the woods are known to have been as follows between the years 1847 and 1904:—

	£	s.	d.
Value of flitterns and saplings, .	12,283	5	5
„ poles, . . .	8,713	0	5½
„ bark, . . .	26,117	2	9
„ cordwood or stackwood,	9,342	0	4
„ fagots or bavins, .	9,184	14	2
„ underwood, . .	813	6	3
„ miscellaneous wood, .	989	19	7
„ timber, . . .	2,964	6	6
„ various items, . .	58	18	6
Total, .	£70,466	13	11½

This amount includes a sum of £2964, 6s. 6d. received by the sale of timber, which was, in all probability, a remnant of the previous crop. As the amount is small, and as its presence in the new crop must have interfered to some extent with the development of the new crop, no deductions need be made from the above total.

By adding the sum of £70,466 to the value of the crop now standing on the area, the total production comes to £165,486, or an average of £1, 1s. 0d. a year per acre.

(b) *The Coppice-Woods.*

These woods are situated in the following parts:—One acre in Holt Pound along the road from Alice Holt Lodge to Mareland House, and 30 acres in Lodge Inclosure, partly forming a narrow strip running along the above-mentioned road,

3. That a plan be drawn up, setting forth the future treatment of all woods, regard being had—
   (*a*) To making the most of the woods financially, without any special desire to obtain immediate, in preference to future, returns.
   (*b*) To the probable supply of labour available.
   (*c*) To giving the best object-lesson in the treatment of woods of this description from a practical point of view, according to the methods of scientific forestry.
   (*d*) Care to be taken that the Lodge Inclosure may be treated so as not to interfere with the amenities of the tenant of the residence, Alice Holt Lodge.

In consequence of the last condition, it has been decided to deal separately with the Lodge Inclosure at the end of this part of the Report.

With regard to the condition 3 (*c*), it may at once be stated that the woods will give the best object-lesson by being treated in a rational manner, in accordance with the instructions indicated above.

2. Treatment of the Oak-Woods.

On reference to the data given in Part I., it will be seen that the distribution of oak-woods, according to classes, is as follows (Lodge Inclosure always excepted):—

	Acres.
Oak-woods of the 1st class (mean height 60 feet and over),	297
Oak-woods of the 2nd class (mean height 40 to 60 feet),	851
Oak-woods of the 3rd class (mean height under 40 feet),	293
Total,	1441

As regards the treatment of the third-class oak there can be no doubt. The data given in Part I. show that these woods attained, in eighty to eighty-five years, a mean height of under 40 feet, a mean diameter of 8 inches, and that the stock on the ground cannot be reckoned at more than 400 cubic feet of timber and five cords of firewood per acre. These are such poor results, that conversion into more useful species is indicated. As a matter of fact, this process was actually commenced some years ago by the Hon. G. Lascelles, and has been continued since, so far as labour was available.

The sample areas taken in first-class oak areas show an average height of 61 feet, a mean diameter of 15 inches, and a

stock of timber of about 1000 cubic feet with about 10 cords of firewood per acre. Although this is a very moderate result, still, taking into consideration the height-growth, and the fact that the woods were heavily thinned in past years, they should be retained as oak-woods. Some difficulty is met with in considering the large areas of the second-class oak-woods. The sample areas show a mean height of 52 feet, a mean diameter of 13 inches, with a probable stock consisting of 700 cubic feet of timber and seven cords of firewood per acre. Taking these figures as a whole, they do not indicate a sufficiently high quality to justify the areas being maintained as oak-woods. It happens, however, that there is a considerable difference in the growing stock in different parts of these woods. There are areas scattered over them which show quite as good oak as the first-class areas, while other parts deserve to be classed as third-class, though too small to be shown separately on the map. Under these circumstances, the only rational way of dealing with the areas shown as second-class oak will be to leave the better parts as oak-woods and to convert the rest into woods of better paying species.

(a) *Treatment of the First-class Oak-Woods.*

As already stated, these woods have been heavily thinned in the past, so that the average acre does not contain more than about 63 trees. Of these it was found on examination of the stock on the sample plots that about 45 are of a sufficiently good quality to be allowed to grow into large timber, while the remaining 18 are of inferior shape and development, and these should be taken out. The cutting of these trees will further reduce the density of the crop, and it is, therefore, proposed to underplant it with beech. This measure will, as soon as the beech has taken hold of the ground, insure a gradual improvement of the yield-capacity of the locality. In some places the remaining trees will be fairly evenly distributed over the ground, in others, they will, more or less, stand in groups, leaving here and there small blanks; these should be planted up with fast-growing conifers, more particularly with larch or Douglas fir (the Vancouver or Oregon variety), species which will have reached full marketable dimensions when the time comes round for the regeneration of the oaks. The more rapidly this measure is carried out, the better for the future development of the

remaining oak trees. The area to be dealt with amounts to 297 acres, and certainly not less than 15 acres should be taken in hand every year, so as to complete the underplanting in not more than twenty years.

The material to be removed may be estimated at one-fifth of the existing crop, or 200 cubic feet of timber and two cords of cordwood per acre, with about two tons of oak bark.

(b) *Treatment of the Second and Third-class Oak-Woods.*

As larger or smaller patches of third-class oak alternate with patches of second-class, more particularly in Glenbervie, Willow's Green, and Abbott's Wood, it is desirable to take these two classes together. The area occupied by them should be gone over at the rate of a certain number of acres annually, the good patches should be treated as described for the first-class oak, the inferior patches should be cleared and restocked with conifers. The nature of the soil indicates as the most suitable species the spruce, which should, therefore, be the principal species to be introduced. On the more sandy part, however, Scots, Corsican, or Weymouth pines may be planted. In localities sheltered from strong wind, a moderate proportion of Douglas fir may be mixed with the other conifers. Larch may be introduced as a sprinkling not exceeding 10 per cent. of the crop; a larger mixture is undesirable, owing to the liability of the tree to become diseased. In damp hollows, patches of ash may be introduced.

It is, of course, desirable that the operations should be commenced in those woods which contain the largest proportion of third-class oak. These are—Glenbervie, Willow's Green, and, next to these, Abbott's Wood.

As the future crop in these woods will, to a considerable extent, consist of conifers, certain precautions have to be taken. The cutting and conversion must be arranged in such a manner that the age-classes are hereafter properly located, that is to say, the older of any two woods must lie on the lee side of the prevailing wind, which, in this case, is the west, south-west, or north-west wind. Another point is that arrangements must be made to avoid a multiplication of injurious insects, more especially of the bark beetles. These two objects will be realised by the following two measures:—

1. By commencing cutting on the east and proceeding gradually towards the west.

2. By allowing a certain number of years (not less than four) to elapse before a second cutting is made adjoining the previous one.

At the outset some slight modification of these measures must be adopted, for the following reasons:—

(*a*) The cutting and replanting of third-class oak areas has already been commenced in the middle of several inclosures.

(*b*) It is desirable to bring the bulk of the remaining third-class oak as soon as possible under the axe.

Under these circumstances, an arrangement on the following lines seems indicated. The *first* cutting series to comprise the northern half of Glenbervie, cuttings to commence on the west side of the plantations of 1886, 1892, and 1893, and to go on by degrees until the western boundary of the inclosure is reached, then to continue in the second-class woods on the eastern boundary of the inclosure.

The *second* cutting series to comprise the southern half of Glenbervie, cuttings to commence on the eastern edge of the third-class oak and to proceed steadily towards the western boundary, then to recommence in the second-class oak on the eastern edge of the inclosure.

The *third* cutting series to consist of Willow's Green. The cuttings to be arranged as indicated on the map.

The *fourth* cutting series to consist of Abbott's Wood, excepting the patch of first-class oak on the western boundary. Cuttings to commence along the eastern edge in the third-class oak and gradually extend to the west. If found more suitable, the number of cutting series can be doubled by dividing each of the above into two. The more numerous the cutting series are, the more independent will hereafter be the management of the coniferous woods.

The total area of second and third-class oak in the five inclosures amounts to 1144 acres, and the question arises, In how many years should the work be done? Assuming that a more or less sustained annual yield is wanted, the work should take as many years as the new coniferous crops require to yield marketable timber. This may be estimated at, say, 60 years. As it is proposed to deal with 15 acres of first-class oak annually during the first twenty years, it may be desirable to reduce during that period the cuttings in the second and third-class oak

accordingly. In other words, to deal with about 15 acres each year, or 300 acres during the twenty years. This would leave 844 acres to be dealt with during the following forty years, or 21 acres a year. The thinnings in the new coniferous woods will commence after about twenty years, so that no reduction of income need be apprehended at the end of twenty years. The thinnings will gradually increase in value, so that a rising income may be expected during the conversion period. At the end of sixty years the woods will be in a condition to give a high sustained annual yield.

Every acre of second and third-class oak, to be dealt with during the next twenty years, may be expected to give about the following yield, considering that about three-fourths belong to the third-class and one-fourth to the second class:—timber, 350 cubic feet; cordwood, 4 cords; oak bark, about 3 tons.

3. Treatment of Lodge Inclosure.

This inclosure is stocked as follows:—

	Acres.	Acres.
Oak-woods, 1st class, . .	18	
Oak-woods, 2nd class, . .	295	
Oak-woods, 3rd class, . .	38	
		351
Coppice-woods, ...		30
New plantations, ...		14
Total area, .		395

The value of the growing stock may be put down as equal to about £18,000. The inclosure is capable of yielding at once a considerable income, which would increase as time went on if it were treated on purely financial grounds. However, it contains a lodge which is leased for a term of forty-one years, and it has been laid down that this inclosure shall be so managed as not to interfere with the amenities of the tenant of the lodge. Under these circumstances, the following treatment is proposed:—

(a) *The Coppice-Woods.*

With the exception of a strip running along the north-east boundary, these woods are situated at the southern extremity of the inclosure. In their middle are situated 14 acres of young coniferous woods, and the remaining coppice might also be converted into conifers as soon as it becomes ripe for the axe.

As the remaining coppice, however, consists chiefly of ash which still pays tolerably well, the authorities may prefer to maintain it for the present.

(b) *The Oak-Woods.*

Only 38 acres are third-class oak. As they are situated at the southern end adjoining the coppice and young plantations, the area should also be converted into coniferous woods. This makes the area to be dealt with under "a" and "b" equal to 68 acres, or about 3½ acres annually, if the conversion is carried out during the next twenty years. The net receipts from sale of produce may be estimated on an average at £70, and the expense of planting at about £20, being an average annual surplus of £50.

The remaining oak, 313 acres, must be managed as a selection forest, that is to say, mature and undesirable trees should be cut by single trees or small groups here and there. If natural regeneration does not come up, planting may be done, especially with beech, and at the end of twenty years the whole question may be reconsidered. By that time matters may be ripe for somewhat more decided measures. Not much revenue can be expected at present. Indeed, it is not likely to exceed £100 a year, if so much, which is a poor return on the capital represented by the value of the growing stock.

Unfortunately, it will not be possible to do much for the improvement of the existing oaks, as systematic cutting out of undesirable trees and underplanting does not apppear practicable. Here the forester must look to the rent paid by the tenant of the lodge, as a compensation for keeping such a big stock of timber, so as to safeguard the amenities of the place.

4. Draining and Road Construction.

A good deal of draining has been done in the past, but it appears as if some years ago this work was somewhat neglected. Of late years, however, the cleaning of existing ditches has been resumed, and what remains to be done should be completed during the next few years. The average annual expenditure during the last five years under this head seems to have amounted to £59.

In the way of road construction only ruts were filled in, parts were levelled, and some brambles cut, at an average annual expenditure of £33. It seems desirable to do something more in this direction. As a commencement, the main rides in Glenbervie might be improved, and then those in Willow's

Green and Abbott's Wood taken in hand. Any reasonable outlay on roads is always more than repaid by increased prices of the timber and cordwood sold from the adjoining areas.

5. Arrangement of Cutting Areas.

The underplanting of the first-class oak should commence on the eastern edge of Straits Inclosure and proceed at the rate of 15 acres a year towards the west. When this inclosure has been completed, the blocks of first-class oak in Abbott's Wood and Goose Green may be taken in hand. The arrangement is so simple that it was not necessary to indicate it on the map.

The arrangement of coupes in Glenbervie, Willow's Green, and Abbott's Wood for the next twenty years, has been indicated on the map. There are 10 coupes in Glenbervie, 5 in Willow's Green, and 5 in Abbott's Wood. Coupes Nos. 1 and 2 in Glenbervie, No. 3 in Willow's Green, No. 4 in Abbott's Wood, Nos. 5 and 6 in Glenbervie, No. 7 in Willow's Green, No. 8 in Abbott's Wood, and so on up to 20 coupes. The areas are not always exactly 15 acres, as it was desirable to take in corners situated between rides. All these coupes are so arranged that cutting and planting proceeds from east towards west, or north-east towards south-west, so that no difficulties will be encountered hereafter when cuttings in the coniferous woods commence. As much third-class oak as possible has been included in these twenty coupes, as well as intersecting parts of second-class oak, to be dealt with as indicated under 2.

The coppice-woods and third-class oak in Lodge Inclosure will be dealt with during the next twenty years, as indicated under 4 (a) and (b).

6. Control of Operations.

An accurate account of all operations should in future be kept in a separate book. Each of the seven blocks should receive a number of separate pages, where the quantities of material removed, the price realised per unit of measurement, the total receipts and the expenditure are recorded year after year. In addition, the area planted, and the cost of planting, as well as that of other works, should be put on record. The information had best be given in a tabular form. . . .[1]

[1] Note.—The detailed Field-Book, appended to the Report, is here omitted as not essential to a proper understanding of the Working-Plan.—Hon. Ed.

XII. *The Conversion of Stored Coppice into Highwood, and how I became converted to the latter System of Sylviculture.* By H. J. MARSHALL, Gayton Hall, Ross, Hereford.

Some fourteen years ago about 180 acres of stored coppice came under my charge, and, very naturally, it became to me an object of much interest. The cutting interval had been eighteen years, and for nine years I followed this course of cropping. From the first, however, I was dissatisfied with the system, and year by year I became more and more convinced of its faultiness; but it had been followed for such a length of time, and was so general throughout the locality, that I had not the courage to break away from it all at once. As a matter of fact, it seemed to me to have every fault that a system of wood-culture could possibly have. At each fall all the underwood and about three-fourths of the standards and tellers were cut, with the result that the standards and young trees which were left threw out lateral shoots in order to protect their roots from the sun's rays, while the older and higher trees swept off the leaders of the lower ones, and thereby checked their upward growth. The result of all this was that hardly any tree, with the exception of those standing in the dingles, was more than 40 feet high, although stored as often as four or five times: *i.e.*, they were 72 or 90 years old, and they were heavily branched to within 12 or 15 feet of the ground. The storing was carried out under great difficulties owing to the density of the underwood, and as this was done "by the piece," it is scarcely to be wondered at that the storer, after struggling up to a standard with his paint-pot and brush, should have marked as many as he could at the same spot before he resumed his journey through the thick copse to mark others. As a consequence, very few young stores had sufficient head-room, and as they could make no upward growth they came down at the next "fall," distorted and stunted, and scarcely worth cartage to the pits. I had fully realised all the drawbacks to the system, when I chanced to have a talk with a charcoal-burner who was at work on some cordwood, derived from the superabundant lateral branches alluded to above. Together we reckoned up that there were 70 tons of stuff to char on about 6 acres of ground, and that as his

employers had only given (and could only afford to give) a shade more for the cordwood than it had cost the buyer of the fall to cut and cord it, the vendor had got nothing at all for the cordwood. It therefore struck me rather forcibly that, as a matter of business, this was not a good transaction. I had then just read Mr Simpson's work *The New Forestry*, and this doubtlessly influenced me in coming to the conclusion that I had given the old system long enough trial, and that it was time to make a change. At that time I had 25 acres stored and offered for sale, the reserve price being £15 an acre, but that offer was refused. The opportunity seemed to me a good one for making the change (although the area was inconveniently large for a commencement), and I therefore offered it "to cut to the stool" at £20 per acre, an offer, which, after a time, was accepted. Assuming that the storage was in the usual proportion, and that ordinarily about three-fourths of the growing stuff had been cut at each fall, I had thus £5 an acre in hand to meet the cost of fencing against rabbits and replanting the ground: and the questions which now required to be settled were—what sort of fence ought to be put up? what kinds of trees ought to be planted? and on what system ought the planting to be done? The fence I adopted consisted of 2 feet of $\frac{5}{8}$-inch mesh wire-netting, placed upright, with 1 foot of 2-inch mesh netting laid on the ground (previously prepared with a grubbing-hoe) outside; and this was laced to the bottom of the upright netting with fine wire, and covered with the soil removed by the hoe. The upright netting was fixed to creosoted stakes, and above the netting were fixed, at 3 inches apart, a line of lightest barbed wire, and, on the top, a line of lightest strand wire, both of which were galvanised. The cost per acre, of course, varies with the area enclosed, but the average may be taken at £1 per acre; and if one's neighbours do not cultivate rabbits too assiduously, the fence should be removable after the sixth year.

The next point to settle was the system of planting. I decided to plant with some particular tree, which was at once valuable and suited to the soil and situation, at 12 feet apart, and to fill in with other kinds, so that no tree or stool should be more than 4 feet from its neighbour. The tree I selected for planting at 12 feet apart was common larch. As it was impossible to use a line, owing to the stool-shoots

having shot up before the ground was cleared, the ground was lined out with 6 foot "feering" poles, as one would line out land for ploughing, the men as they dug the holes in one line turning the poles end-over-end once to fix the next line, and so on. It is well to have plenty of these poles (say one to every 30 yards), so as to be able to keep the lines straight without difficulty. As no stools were grubbed out, and as only those which were worthless, such as hazel, etc., were destroyed, the distance of 12 feet between the planted trees could only be strictly maintained along the lines, the distance apart of the marking trees in the lines being as nearly 12 feet as the old stools would permit. I may say here that I selected common larch for this purpose in the belief that at such wide intervals, and separated by other trees, they would not suffer from canker; but in this I have been disappointed, and I am now using Douglas fir, and, where the exposure is too severe for these, Japanese larch. The intervals between the larch were filled in with ash, sycamore, and Spanish chestnut, and in wet spots and frost-holes alder and black Italian poplar were used. I am about to try elm also. The stools which were destroyed were treated with common agricultural salt, 2 to 4 lbs. being used per stool, according to its size, and they were covered with a turf to prevent the salt from being washed away, a precaution which I find necessary. This method of treating the stools gives satisfactory results, although the salt used has run up in one instance to as much as 8 or 9 cwts. per acre.

Up to the present time I have made what I consider to be a mistake in "falling" right up to the boundary, and planting Scots and Corsican pine as a wind-guard. Instead of this, I should have left a belt of the coppice standing to answer that purpose, and I am now leaving intact a strip of standards and underwood 8 yards in width along the margin.

Early clearance is of the utmost importance; and now that it no longer pays to strip oak, there should be less difficulty than heretofore in securing early clearance. My last three falls (including this year's) have been subject to clearance by 25th November, which gives December and January for preparing the ground for planting in February. This plan works fairly well, though a clearance by 25th October would be much better, as it would give some time for autumn planting. I would also

suggest to anyone carrying out conversion of this sort, to embrace the opportunity to plant new kinds of trees, such for instance as *Cryptomeria japonica*, *Thuya gigantea*, and *Picea sitchensis*. The two former grow well here on sand or clay, and the latter on clay. I have also planted *Pinus ponderosa*, but so far I have not found conditions suitable to enable it to grow quickly enough to hold its own in the struggle with other species.

Now as to the financial results. It is more than probable that the first question a landowner will ask when this course of treatment of his coppice-woods is proposed to him, will be—"What will be the immediate effect on the income from these woods? I can quite understand that my children and grandchildren will benefit. They will no doubt have trees 90 to 100 feet high where I have never had anything over 45 feet, and will get a much bigger yield per acre, but what shall I get for the first eighteen years after conversion?" And the answer is not altogether simple or easy. Presuming that there are plants at 4 feet apart, there will be 2722 trees of all sorts per acre to begin with. It will not be desirable to reduce the stool-shoots retained much below 4 shoots per stool for the first six or eight years, but by the eighteenth year the plants should be reduced to 680, and the intervals increased to 8 feet, so that between the ninth and eighteenth year about 2000 poles will have been cut out and disposed of. These will be chiefly of oak, ash, chestnut, and sycamore. In different localities the price realised for these will vary very greatly, but if it be put at 2d. per pole, it comes to £16, 13s. 4d. per acre, which is considerably above the average price realised for the periodic fall of coppicing in this country. At half that price the loss (if any) would be more than counterbalanced by increased value of the crop left standing, which at 1½ cubic feet per tree would be about 1000 feet per acre, and this at 6d. per cubic foot would be equal to £25, as compared with the five pounds' worth of timber left standing after a fall of coppice.

As to the cost of replanting, I must admit that it is almost impossible to fix a figure for all cases. First of all, the number of stools left per acre will vary, and in consequence the number of young trees required will also vary; and afterwards the cost of the young trees will vary very greatly. According to my experience, it is cheaper in every way to plant nothing under 3 feet high, and I prefer 4 to 6 feet high wherever the exposure is not excessive.

If a nurseryman has to keep his plants till they are of this size a very big price will have to be paid for them, and the carriage is also costly; but with a home nursery the cost will be well under 30s. per 1000 for all plants bought and nurseried, and if sycamore and ash seedlings were dug up in the coverts or shrubberies, they could be nurseried at considerably less cost. At 12 feet apart there would be 302 conifers per acre, and, as a rule, it is not easy to find room for more than 500 deciduous broad-leaved trees in addition to these, so that £1, 10s. should cover the cost of trees, while another £2 should not fall far short of paying for planting and cleaning. In a plot of 8 acres replanted this year, where the stools were rather thin, I found room for 3373 conifers and 2430 deciduous broad-leaved trees, and I expect to get in 800 more of the latter next spring, making 422 conifers and about the same number of deciduous broad-leaved trees per acre; but with regard to this I must explain that the need of 120 extra conifers was due to the lower part of the ground having been planted at 12 feet apart with Douglas fir, and the intervals filled up with common Japanese larch in place of broad-leaved trees.

If trees of 4 feet and over are planted, the cleaning or weeding will be little more than thinning the stool-shoots; but where smaller trees are planted the mass of rubbish that comes up smothers the conifers in the first summer unless it be cut over, and this is a costly process (it has cost me as much as 20s. an acre), and is destructive of the seedlings from the former crop, which it is of importance to preserve. With bigger plants it is only necessary to cut the brambles and honeysuckle, and this can be done after Christmas, when the grass, thistles, nettles, and bracken have died down and the seedlings can be seen. I have worked out the total cost on 10 acres, including clearing up to the fifth year from planting, at £58, 15s., but I think this may be reduced with the larger trees I am now planting.

XIII. *The Destruction of Rabbits Injurious to Woodlands and Fields.* By the HON. EDITOR.

Although of late years rabbits have on many estates formed a favourite kind of game, there can be little doubt that these prolific animals very often cause serious loss to field-crops, pastures, and woodlands. So much so is this the case, indeed, that wild rabbits are truly classifiable as "vermin" of a dangerously destructive type, which ought really to be almost exterminated, and their preservation allowed only within warrens properly fenced to prevent their egress to adjacent fields and woodlands. It is highly improbable that landowners have anything like a correct idea of the total amount of direct and indirect loss, expressed in money-value, annually caused by rabbits; and a true bill of charge and discharge would probably astonish rabbit-preserving landed proprietors considerably. Even though tenant-farmers have now the right of shooting rabbits, the existing legislation does not seem to go anything like as far as seems desirable in the national interest. It would be a very good thing if rabbits were actually classified as "vermin" when found outside of properly-fenced warrens, and if a note to this effect were printed on gun-licenses, in place of the note which now states expressly that they "are *not* vermin" for the purposes of the same.

Even where it is desired to keep down rabbits, it is often found difficult to do so. Constant shooting is laborious and by no means successful; nor is trapping any easier and more successful, while ferretting is slow and expensive. It may therefore be of interest to those desirous of reducing to very low limits a plague of rabbits, to know the results that have been obtained on the Continent from the use of bisulphide of carbon to suffocate them in their burrows.

Bisulphide of carbon (CS_2) is a heavy, colourless, and highly inflammable liquid, having a disagreeable odour and taste. It is soluble in alcohol but not in water, and is a powerful solvent of sulphur, phosphorus, fats, and india-rubber. It is therefore used extensively in vulcanising india-rubber. It can be bought in bulk, or may be prepared by heating pieces of charcoal to bright redness in a porcelain tube, and passing sulphur vapour along it. When freely inhaled, its vapour acts anæsthetically, like chloroform and ether; and where it is used as a solvent in

caoutchouc and other manufactures, the workmen employed are apt to suffer from headache, loss of appetite, and impaired sight and hearing. But, while its injurious action on the human nervous system thus causes general derangement of health, it is fatal to rabbits; and bisulphide of carbon is therefore perhaps the best means of suffocating them in large numbers—unless this be held to be "poisoning," and therefore contrary to Section 6 of the Ground Game Act, in which case the Statute ought to be amended, as this means of suffocation by an anæsthetic should be as nearly as possible painless—and at a comparatively small cost. As it is highly inflammable, care must be taken when using it.

For carrying out operations three men are needed. One of these carries a large tinful of the poison and a supply of rags for saturating and shoving into the rabbit-holes, while the other two stop up most of the entrances and exits. The most convenient size for each rag is about 10 or 12 inches square. It is crumpled into a ball, held in the left hand, and saturated by pouring the poison on to it from the spout of a little cup with a closed lid—this small vessel being refilled from the large tin as occasion requires. Immediately on the rag being saturated at the mouth of the burrow, it is shoved home into it with a stick about 4 feet long, while the second man thrusts in a handful of small twigs, and then closes the hole as quickly as possible with a mattock, and rams down the earth firmly. As fast as he can, the first workman saturates and inserts another rag into another hole, which the third workman also immediately closes, after shoving home a handful of brushwood to prevent the rag getting covered with sand and earth, and thus rendered comparatively ineffective.

On burrows that have many entrances and exits, several holes are thus operated upon, but not all of them, so that the poisonous gas circulates throughout the whole burrow. During dull, damp weather, and in the early morning are the best times for operating, as the rabbits are then most likely to be inside their burrows; but it is always best to sound wooden rattles to drive them in before beginning operations. The best time of the year for taking this measure is from November to March.

It is not claimed for this that it will exterminate rabbits; but where they exist in large numbers it is an easy and effective means of even more than decimating them quickly and cheaply

on farm-land and woodland, where shooting and trapping are difficult, costly, and less effective. Actual experiments have proved that where wild rabbits swarm in large numbers they can by one well-conducted operation be reduced to about one-twentieth; and wherever extermination is desired, ferretting can then be trusted to do the rest. But, of course, it stands to reason that where even about 5 per cent. are permitted to survive, poisoning will have to be repeated from time to time, to keep the pest well in hand.

Experimental measures of the above sort were taken with marked success in adjoining fields and woodlands on thirty-three estates throughout the Grand Duchy of Hesse during 1903; and from these some interesting details are obtainable as to cost and result. In one case operations were conducted over an area of 2125 acres (1425 acres of woodland and 700 acres of fields) at a cost of £51, 13s., or less than 6d. per acre, of which rather more than one-half was for material and rather under one-half for wages. The result was very good, about nineteen-twentieths of the rabbits being killed off. In another case 4353 burrows were operated upon at a total cost of £20, of which £13 were spent in wages, £5 on bisulphide of carbon ($6\frac{1}{2}$ cwts. being used), and £2 on rags, etc. On another estate 10,530 burrows were treated at a cost of £45 (or under one penny per burrow), of which £29 was for labour, £13 for bisulphide of carbon, and £3 for rags, etc. In all of these cases the results were highly successful, but the operations will have to be repeated again to keep the rabbits from increasing unduly.

Probably there are many places in the British Isles where a trial of the above method might with advantage be made by landowners desirous of keeping down rabbits.

XIV. *The Training of Probationers for the Indian Forest Service.*

By the HON. EDITOR.

When the national outlook for shipbuilding timber caused the British Government great anxiety about the navy towards the end of the eighteenth century, partial relief was obtained by the use of the teak-timber found along the western coast of India. The extraction of teak by the Bombay dockyard authorities gradually led to the formation of a Forest Department, and a similar branch of Public Works was also subsequently started in Madras. After the annexation of the Tenasserim Provinces of Burma in 1826, the extraction of teak from the forests drained by the Salween and Attaran rivers formed part of the duties of the Civil Engineering Staff; but when the Pegu and Martaban provinces were added thereto in 1852, a Forest Department was formed under a Conservator of Forests. In each of these three different parts of British India, medical men rendered the most valuable services as Conservators of Forests, viz., Dr Gibson in Bombay, Dr Hugh Cleghorn in Madras, and Dr MacClelland in Burma. On the resignation of the last-named in 1855, Dr (now Sir Dietrich) Brandis became Conservator in Burma, and was so successful in his administration that, in 1862, he was (along with Dr Cleghorn from Madras) deputed by the Government of India to examine and report upon the forests of Northern India, with a view to the introduction of conservancy measures. The result of these two reports on the western and the eastern forest tracts skirting the base of the Himalaya mountains was the establishment, in 1863, of the Forest Department of India as an Imperial Department, absorbing the purely provincial departments in the Presidency of Bengal, and exercising a controlling supervision over the Forest Departments in the other two Presidencies, Bombay and Madras. The choice of an Inspector-General of Forests fell on Dr Brandis, who held this high office till 1882, when he attained the age-limit of sixty years.

For the first few years Forest officers had to be appointed without any special training, the service being recruited from the Indian army and by the appointment of those seeming qualified for the rough, adventurous life in the jungle, and fond of camp life and sport. It very soon, however, became

apparent to Dr Brandis that it was absolutely necessary to ensure a regular supply of young officers who had undergone a thorough course of training in Forestry; and, after a vast amount of correspondence, the Government of India and the Secretary of State acquiesced in the proposals he urged on their attention. In 1866 two young German foresters were selected for appointment to the Department, Dr W. Schlich and Mr B. Ribbentrop—who, later on, became Dr Brandis's successors as Inspectors-General (from 1882-1885, and 1885-1901)—and in that same year the first competitive examination was held in London for probationers, who were to be trained, some in Germany and others in France, for two and a half years before joining the Department as junior officers. This course of training lasted down to 1875 in Germany, and down to 1886 in France (at the Nancy Forest School); but, beginning in 1885, for the last twenty years the technical education for probationers has, for the most part, been given at the Indian Engineering College, Coopers Hill, Surrey, by Dr Schlich, assisted since 1888 by Mr Fisher,—this collegiate course being amplified by tours in French and German forests, and followed by a six months' residence in a North German forest, giving better opportunities than are available anywhere in Britain for seeing practical work carried out methodically on a large scale.

For exactly twenty years, therefore, Coopers Hill has been the place of instruction for the probationers for the Indian Forest Service. The main reason of its ever having been selected for this purpose was that, owing to the fall in the exchange value of the rupee or silver currency, and the consequent shrinkage in Public Works over twenty years ago, Coopers Hill was too expensive to be maintained by the Government of India only for a decreased number of Civil Engineer probationers; and the new rules introduced in 1885, as regarded probationers for the Indian Forest Service, relieved the financial position of Coopers Hill.

With the changing circumstances brought by time, however, the whole question of maintaining Coopers Hill cropped up again,—with the well-known issue that in the spring of 1904 the Secretary of State for India decided to close it after July 1905. Ample provision exists in various parts of the United Kingdom for the training of Civil Engineers; but the question of dealing with the Forest probationers had to be also considered,

and it was resolved to transfer the two Forestry professors (paid by the Government of India only) to a University centre. Cambridge and Oxford entered into keen competition for the reversion of these Indian Forestry students; and Oxford, having apparently had most to offer in the way of immediate advantages, won the day, so that since October 1905 the lecture course in Forestry is being delivered there, and is to be followed by twelve months' residence in a German Forest.

This move to Oxford is perhaps, however, only of a temporary nature. Cambridge protested vehemently (and one can easily understand why) against Oxford receiving such one-sided support from the Secretary of State for India, and Edinburgh University naturally also joined issue; and the effect was that the Secretary of State has promised to reconsider his decision within the next three years, the Oxford training in the meantime being thus limited to the summer of 1908. Under these new temporary rules, the next competitive examination, to be held in August 1906, is in the following subjects:—(1) mechanics and physics, (2) chemistry, and (3) botany. It seems a pity that the examination shall not extend to *all the main sciences directly cognate to Forestry*, viz., (1) chemistry, (2) geology and soil-science, (3) botany, and (4) zoology—because a fairly well-correlated knowledge of the elements of these four subjects would undoubtedly form the best foundation for the study of the theory and the practice of scientific Forestry.

Apart from the several Agricultural Colleges where Forestry now forms part of the curriculum prescribed for land-agents and other students, University courses of lectures are given at Edinburgh, St Andrews, Newcastle, and Bangor; and Cambridge will almost immediately also provide a course of technical instruction.

How far these courses of instruction may go towards being considered *thorough* in all the four branches of Forestry, has nothing to do directly with the training of probationers for the Indian Forest Service. But that must certainly have a very direct effect, if it may perhaps be the intention of these Universities to combine within the next three years, and urge the Secretary of State to throw open the Indian Forest Service, from 1908 onwards, to the competition of all University students who have undergone an adequate course of instruction in all the four branches of Forestry.

Such a decision would relieve the Indian Treasury. If the Government of India can annually obtain probationers well qualified in Forestry by open competition, then all they would need to provide will be a special course of lectures on "Indian Forestry" at Oxford, or else organise a six to eight or twelve months' course at the Imperial Forest School at Dehra Dun. The latter would probably be the preferable method, as well as the cheaper; it would be best for the work of the Department, and best for the young officers themselves. It would train these most easily and quickly to practical work in jungle and office, would accustom them to camp life and methods, and would make them of greater use when only commencing their official life. And the opportunity it would also give of making all of them study Hindustani would be of much advantage, both to the young officers and to Government, because there is no province in India where a knowledge of Hindustani is not almost essential for the proper performance of a Forest officer's duties, in addition to the prescribed *official language* of each province, in which lower and higher standard examinations have to be passed as stepping-stones to promotion.

As it will no doubt interest our readers to learn something about Forest work in India, a short account of the chief timber-trees will be found on page 111, and notes on Indian Forestry during 1905 on page 128.

XV. *The Chief Timber-Trees of India.*

By the Hon. Editor.

In such a vast country as India, extending over about 40° of longitude and 20° of latitude north of the equatorial line, there is of course a great variety of climate, and consequently also of botanical regions, each characterised by its own peculiar flora. There are vast tracts, larger than some of the countries in Europe, which have an arid and in some years almost a rainless climate, as in Sind, Rajputana, and portions of Central India and the Punjab; while towards the extreme east the notorious Cherrapúngyi, situated in a bend of the mountains which catches the moisture-laden southern monsoon winds and cools them down, has the largest known rainfall in the whole world, an average of 640 inches, or 53⅓ feet a year. And when to this enormous variation between the extremes of drought and of moisture are added not only equal, but also even greater variations and extremes of heat and cold, ranging from the eternal snows of the great Himalaya Mountains to a temperature often about 115° to 120° in the shade during the hottest time of the year, it can easily be understood that tropical, subtropical, and alpine India offers, as Sir Joseph Hooker remarks in the Introduction to his *Flora of British India*, perhaps the richest, and certainly the most varied botanical area on the surface of the globe. And elsewhere he estimates that the Indian flora includes about 15,000 different species of plants.

As might of course be expected with such a general wealth of flora, the typically forestal vegetation likewise shows great variations, and occurs in vast abundance in most parts of the country which are not thickly populated. There has as yet been no general botanical survey of the trees, shrubs, and woody climbers which are to be found in the forests and jungles; but, in the Introduction to the second edition of his *Manual of Indian Timbers*, Mr Gamble estimated that there are about 4749 known species actually indigenous to India, including 2513 trees, 1429 shrubs, and 807 woody climbers. It may, perhaps, give some idea of this enormous botanical wealth and variety, when it is stated that there are only 134 species of woody plants in the British Isles, so that the Indian forest flora is at least 35½ times as rich and varied,—and probably much more so, because many of the

wild and unadministered forest regions of Farther India have not yet been examined.

Among all this wealth of woody fibrous plants, about 1450, including exotics, have been described in Gamble's *Manual* with regard to their general appearance and the character of their wood. But what may be termed the chief timber-trees of India consist of about thirteen kinds, a baker's dozen (teak, sál, deodar, sissoo, babul, juniper, kheir or cutch, blackwood, sandal-wood, red sanders, and the three ironwoods—pyingado, nahór, and anján), while a fourteenth, the *mahwa* of Central India, though also yielding excellent timber, is of much greater value for its flowers, the sweet and fleshy corollas of which form an important article of food through the local forest tracts.

In point of actual monetary and mercantile value the TEAK-TREE (*Tectona grandis*) is *facile princeps* the most important of all the forest trees in India. Its moderately hard, golden-brown wood, which darkens considerably with age, is easily recognisable from the strongly-scented essential oil to which this timber owes its special suitability for shipbuilding—an oil which preserves steel and iron, in place of corroding them like the tannic acid contained in oak. The finest development of the teak-tree is attained in the mixed deciduous forests of Burma, whence about one and a half million pounds' worth of this timber is annually exported. But it also occurs scattered throughout the dry forests in many parts of the Central Provinces and Madras, and on the Western Ghâts in Bombay. It was from these Madras and Bombay forests, situated conveniently near the coast for shipment to Bombay, that considerable supplies of this fine timber were first of all obtained for local shipbuilding, and then for export for the use of the English navy about a hundred years ago, when the existing stock of home-grown oak had become almost exhausted, and when the national outlook for ship-building timber, during the time of our continental war, had reached its very gloomiest stage. It seems to thrive best in places with a mean annual temperature of between 70° and 80°, with a definite alternation of wet and dry seasons of the year, and without extremes of heat and cold. It is not exacting as to soil or aspect, so long as the drainage is good. Teak is not a truly gregarious tree, but is usually to be found associated with many other deciduous trees growing above an underwood of bamboos. It seeds freely, and germinates fairly well in clear

places; but, unless artificially protected, the seedlings which come up are for by far the most part either choked by young bamboos or weeds, or else are burned down year after year by jungle fires. Thus, in fire-swept areas, where jungle fires run over the ground every year some time during the hot season lasting from the middle of March to the middle of May, young shoots are thrown up time after time for ten to twenty years, and sometimes more, until at length a stronger growth or some happy chance enables them to shoot upwards and assert themselves in future. In the Burmese forests the association of teak with bamboos is taken advantage of to make sowings at the periodical flowering and dying off of the bamboo undergrowth, at intervals varying from 15 or 20 to over 50 years, according to the kind of bamboo, because it is only then that the seedlings can be expected to have any chance of getting their heads up high enough to escape being out-grown and suffocated by the young bamboo shoots thrown up in ever greater lengths year by year unless checked by shade overhead. Plantations are also largely formed to provide larger supplies in the future; and, besides this, much assistance is given in the way of protecting large forest areas from jungle fires, and of killing inferior species of trees by "girdling" or ringing them into the heartwood in order to increase the proportion of teak. It has a strong upward growth and a marked tendency to clean itself spontaneously of side branches, even when not grown in close canopy; and in plantations it runs up, straight as a plummet-line, to a height of about 75 to 80 feet in the course of 15 to 18 years. Working-plans have been introduced into all the chief forests in Burma to determine the number of mature trees that can be cut in each during the next 30 years, so that there may be no danger of overworking any tract; and it has been found that, on the average, it takes a teak-tree from 150 to 180 years of age to attain the mature marketable size of 7 feet in girth, measured at 6 feet above the ground, the rate of growth being of course quicker in the fairly moist than in the very dry forests. The investigations made in order to arrive at these practical conclusions showed that, while the average rate of growth is about 12 annual rings per inch of radius (a rate often equalled and even exceeded in the case of our own oaks and other hard-woods), the average age of a 3 feet tree is 68 years, and that after this it takes other 29 years to reach $4\frac{1}{2}$ feet girth, 35 more

to attain 6 feet, and other 27 to reach the fully mature girth of 7 feet. Under favourable circumstances teak attains very large dimensions. In the Kyaukmasin forest in Burma, 26 years ago, I measured several huge, but usually rather stunted, trees varying from 20 to over 24 feet in girth at 6 feet up; and gigantic logs have been floated out having the fine dimensions of 64 feet by $13\frac{3}{4}$ feet mean girth, and $82\frac{1}{2}$ feet by 10 feet mean girth. When quite fresh, teak timber is hardly floatable, but after being "girdled" and allowed to season on the stool in the forest for two or three years it is easily raftable. Although some of the finest forests have of late years been overworked, the measures taken for the protection of this splendid timber are such as to secure not only the continuous maintenance, but also largely increased supplies of it in the future.

The SÁL-TREE (*Shorea robusta*) occupies, like the teak, two of the distinct forest regions of India. It grows more or less gregariously in the form of a belt skirting the base of the Himalayan range, and clothing the valleys and lower hills to a height of 3000 to 4000 feet, while it also occurs similarly in Central India, extending from the Central Provinces into Rewa, Orissa, Jeypur, and Vizagapatam. It is a very hard, heavy, coarse and cross-grained timber of great durability, though it is a very difficult wood to season owing to its liability to warp and split. But as regards durability, strength and elasticity, well-seasoned sál is perhaps the finest of all the Indian timbers—except, perhaps, the pyingado or ironwood of Burma. It is chiefly used for railway sleepers, though also largely employed for general constructive purposes, such as bridges, piles, beams, etc. As it is not floatable, difficulty is experienced in extracting it in large logs from the forest. It is usually found growing on shingle and sand, or on loam resting on gravel. As it produces seed abundantly, and as the seeds ripen just at the beginning of the annual rains and germinate readily, the large-leaved and shade-bearing seedlings soon manage to choke all other seedling growth and to assert themselves gregariously. The young seedling crop, however, usually disappears year after year, either in consequence of frosts by night or of sun-scorching by day, while jungle fires kill them wholesale unless the area be specially protected; and it is not until, after some years, the roots have penetrated down to a permanently moist subsoil that the young plants

are able to assert themselves against this annual dying down of the shoot. The finest growth of the sál is attained near the foot of the Nepál hills, where trees grow to between 100 and 150 feet high, with a clear stem of 60 to 80 feet and a girth of 20 to 25 feet. Climate and soil of course cause considerable variations in the rate of growth of this as of other trees; but it has been found that it usually takes from 80 to 100 years to reach a girth of 6 feet, and consequently a rotation of about 100 to 120 years has been adopted in the forest working-plans. Protection against fire, and improvement-fellings to replace badly-grown stems by those growing under more favourable circumstances and to reduce the proportion of inferior species throughout the crop, are the chief measures taken by the Forest Department to preserve and increase this very valuable timber; and no doubt the effect of these measures will be to largely increase the available supply for future generations.

The DEODAR, or "GOD'S TREE" (*Cedrus Libani* var. *Deodara*), the most important and valuable of the northern Indian timbers, furnishes a light, moderately hard, strongly scented and oily wood of a pale yellowish-brown colour. It is chiefly to be found in the western Himalayan regions, at an elevation of about 6000 to 8000 feet, whence it extends to the mountains of Afghanistan. Except in the case of sacred groves around temples, and in some parts of Kumaon, the Punjab, and Kashmir, it is rarely to be found growing gregariously and forming pure forest; because it usually occurs in family groups interspersed among its characteristic associates, the Himalayan spruce (*Picea Morinda*), the blue pine (*Pinus excelsa*), three kinds of Himalayan oaks, and sometimes the Himalayan silver fir (*Abies Pindrow*), cypress and yew, and the long-leaved pine (*P. longifolia*) at lower elevations. But, besides these more frequent kinds of trees, the deodar forests contain a rich variety in the Indian birch, poplar, horse-chestnut, elm, hazel, maple, cherry, holly and rhododendron, together with an undergrowth of shrubs closely related to many kinds common in different parts of Europe. Two well-marked varieties of deodar grow in those forests, which are said to run true to seed. One of these has a dark green, and the other a silvery foliage; but the latter is comparatively infrequent, and is chiefly to be found at the foot of low-lying ravines. The deodar has naturally a spreading and very beautiful habit of growth, and unless this

up, so as to leave immature trees and the new crop—a procedure which of course requires to be varied according to the given circumstances. Being light, the timber floats well; and most of the deodar logs brought out from Kashmir and the Punjab, and the sleepers worked out from the Tons and Jumna valleys in the United Provinces, are drifted or rafted down the streams.

The Sissoo or SHISHAM (the "Shittim" wood of the ancient Jews, *Dalbergia Sissoo*) grows gregariously in the river-beds of streams and on the sandy or stony banks of torrential rivers all along the sub-Himalayan tract and the valleys up to 3000 feet from the Punjab to Assam, whereas elsewhere it sows itself only sparsely throughout the plains of Upper India. Its very hard, close-grained, brownish heartwood, streaked with dark longitudinal veins, does not show the annual rings at all distinctly; but it is a decidedly ornamental wood, which seasons well without warping or splitting, takes a good polish, and is admirably adapted for carving as well as for all purposes where strength, toughness, and durability are demanded. In furniture and carving, indeed, it is one of the finest woods in India, being perhaps rivalled in this respect only by its very near relative the blackwood (*D. latifolia*). Though it reaches a height of about 60 feet or more, it does not run up in a clean, straight stem, but is often buttressed, gnarled-like and twisted, so that it seldom can be got to yield good, straight logs. It is of rapid growth at first, but soon decreases to a slower rate. It does not usually grow to more than about 6 feet in girth, although occasional stems of 10 and 12 feet near the ground are not altogether uncommon. Even when growing gregariously the Sissoo trees bear an extremely light crown of foliage; and being exceedingly light-demanding, it soon thins itself gradually during the pole stage of growth. The pure or almost pure patches of Sissoo forest to be found on the sandy river-bed lands of Upper India are formed from seed washed down in the pod while the streams are in flood. As the pods are indehiscent, they gradually rot away till the seed is enabled to germinate, and the young seedling utilises most of its energy at first in forming a long tap-root of about 6 feet in length, which fixes it in the soil and prevents its being washed away during the floods of the following year. As the sands become deposited here, this gradually raises the level of the ground and forces the water to deepen the channels alongside, so that the young crop gradually rises above the surround-

ing water-level, and occupies separate islands or terraces. On suitable soil Sissoo can easily be grown from seed, although it is a difficult tree to transplant owing to its long root-strands. It is a prolific seed-producer, and seeds itself easily, while its natural reproductive power is often increased by a free production of root-suckers. Under favourable circumstances it attains a girth of 30 inches in 12 years, and 54 inches in 30 years, representing respectively $2\frac{1}{2}$ and $3\frac{1}{2}$ annual rings per inch of radius; but in the celebrated Changa-Manga plantation, formed by irrigation with canal-water near Lahore, many of the trees averaged 4 feet in girth at 12 years of age; while in the natural forests in Oudh an average girth of 36 inches and height of 50 feet is attainable in 16 years, or at the rate of 1 inch of radius in $2\frac{3}{4}$ years. As in the case of all the other more valuable timber-trees, much is being done to increase the supplies required for future use.

The Bombay BLACKWOOD, perhaps better known in England as "Indian rosewood" (*Dalbergia latifolia*), is a valuable and extremely hard and close-grained furniture wood of a dark purple colour with black longitudinal streaks, deepening with age, in which the annual rings are quite indistinct. It is found throughout the whole of the Indian peninsula, but not in Burma, and it attains its finest growth along with teak and bamboos in the dry forests of the Western Ghâts, where it ascends to an elevation of about 3500 feet. It is essentially a tropical tree, and attains its finest growth in the southern localities. Though not an uncommon tree, it is nowhere abundant. It can be easily raised from seed, besides freely sowing itself naturally, and it has a strong reproductive power in throwing out coppice-shoots. It is a tree of slow growth, though it ultimately reaches a height of 80 feet, with a girth of from 12 to 15 feet, the largest recorded specimen being 20 feet. It takes about 100 years to attain a girth of 6 feet. The black carved tables, chairs, sideboards, etc., made of this fine wood are not as fashionable now as they used to be, so that there is in some places less demand for the wood than formerly. One result of this has been that it has been used for sleepers; but, though well suited for this as to durability, it seems a pity that so fine a timber should be used for purposes for which less beautiful woods are equally well adapted. In these days of specialities in furniture, it should pay some large firm to develop the blackwood industry in Britain.

The BABÚL (*Acacia arabica*), a tree of moderate size, with hard

pinkish-white heartwood turning reddish-brown on exposure and mottled with dark streaks, is one of the most important trees in the arid regions of western and northern India. Its true home is among the sandy wastes of Sind, Rajputana, Guzerat, and the North Deccan, but it is also found self-sown and cultivated throughout all the drier regions of Central and Upper India, and much is done for its cultivation in Sind and the Punjab. Sometimes it grows gregariously in patches, sometimes merely scattered about in single trees or small knots. In these dry tracts, usually poor in timber, it is an exceedingly valuable tree, yielding not only fine timber, very durable when well seasoned, and much used for wheels, sugar and oil presses, rice pounders, agricultural implements, etc., and making excellent fuel, but also furnishing tanning and dyeing products from its bark and pods, while the branches and leaves are used as fodder, and the thorny boughs for fencing fields. The babúl tracts of the arid regions are therefore carefully reserved and worked systematically. Though babúl is a free seed-producer, reproduction is often difficult within the reserved areas, as insects destroy the seed. To obviate this difficulty goats are often grazed inside the reserves and allowed to feed on the pods, and when the seeds pass through undigested they have a better chance of germinating. Otherwise it has good reproductive power and coppices well, while it may also be grown from cuttings. Though not usually a large tree, it reaches a height of 50 to 60 feet, with a girth of 6 to 8 feet, the largest known tree being one at Pandharpur, in Bombay, 80 feet high and 14 feet in girth. In Sind it usually takes about 35 years to reach 4 feet in girth, and about 55 to attain the mature girth of 6 feet, while its rate of growth is generally quicker in the Punjab. In some parts of Madras the babúl forests are worked as coppice-under-standards, with a rotation of 20 years, in order to furnish supplies of much-needed fuel and fencing-thorns.

The INDIAN JUNIPER, or HIMALAYAN PENCIL CEDAR (*Juniperus macropoda*), is one of the most important timber-trees in Beluchistan, whence it extends westwards into Afghanistan and eastwards to Nepal, growing at elevations varying from 5000 to 14,000 feet. Its light, moderately hard, and fragrant wood, red in colour and often with a purple tinge, though it has little strength, is used in these districts, where timber is at a premium, for all sorts of purposes, from building temples, and forming

beams and wall-plates, to drinking-cups and walking-sticks, while it is also used as fuel and burnt as incense. The bark at the base of old trees is of immense thickness, and is pulled off in long strips and used for roofing huts. This juniper forms pure forests at Ziarat in Beluchistan, and in the Pil and Zarghun ranges, while in the Hariáb district it forms fully half of the forest at 9000 feet, and has *Pistacia*, a kind of ash, and the ebony prune as its chief associates. The finest tracts of juniper are those of the open forests of Ziarat, about 60 miles to the east of Quetta, the capital of Beluchistan, where they extend for over 200 square miles. The trees generally branch from the base, straight stems and clean boles being very rare. The lowest branches are often buried in leaf-mould and dead foliage, so that they have the appearance of younger growth rising up round a parent stem. The rate of growth is slow, though the trees occasionally rise to a height of 70 feet and attain a girth of 20 feet. Although it reproduces itself naturally from seed, it often happens that very few of the seedlings survive, owing to fire. Throughout these juniper tracts the hill-sides still show remains of old stems killed through fires lit against them by shepherds at night, in order to scare wild beasts from the flocks,—a practice that is now, fortunately, almost extinct. Happily, too, most of such dead trees are surrounded by a younger generation of saplings, poles and young trees growing vigorously without much shelter. The principal agent in sowing the seed is a bird called the "Obisht-khwarak," or juniper-eater. Though slow, the reproduction of these forests is now ensured, and the fears once entertained as to maintaining the supply of wood for future use are now at an end. In its Himalayan habitat the juniper is usually found growing gregariously on rocky slopes, where it does not generally grow over about 50 feet in height, though its girth is often considerable, 6 to 7 feet being not uncommon. Exceptional girths of 20 feet and more are sometimes reached, the largest being 33½ feet, at Lahoul.

The KHAIR, or CUTCH-TREE (*Acacia Catechu*), is a tree of exceptional value, not only on account of its very hard, heavy, and durable wood, varying from dark red-brown to light brick-red in colour, but also, and more particularly, from the brown-black astringent product, the "cutch" of commerce, obtained from boiling chips of the heartwood, and known as *kath* in Northern India and *sha* in Burma, the preservative dye used to

produce the dark brown colour of sail-cloths, fishing-nets, etc. The wood is a splendid timber, which takes a fine polish and is extremely durable, defying both white ants and the teredo. The only reason of its not being very extensively used as timber is the unfortunate fact that it does not grow to large dimensions. The cutch-tree is common in the lower deciduous forests of most parts of India and Burma where the rainfall is moderate. In Burma its distribution extends very little above the tropic line, but in Upper India it spreads to the sub-Himalayan tracts west of the Indus, and there ascends the valleys to a height of about 3000 feet. There are three distinct varieties of this tree, in which the calyx, petals, and rachis of the leaves are respectively hairy, downy, and smooth. The hairy variety is that common to the dry regions of Upper and Central India, but rare in Burma; the downy kind is that found chiefly in the much moister locality of Bengal, Sikkim, Assam, and Burma; while the smooth variety is confined to the arid regions of the Deccan, Carnatic, Rajputana, Western India, and the dry zone of Upper Burma. In India the khair or light red variety is found, both sporadically and also more or less gregariously, interspersed among the other deciduous trees characteristic of the dry forests. When gregarious, it is usually found—like the Sissoo, though seldom growing along with it—on newly raised banks in beds of streams issuing from the mountain ranges, down which the seed-pods are borne by the waters, and get lodged among the sand and boulders of the freshly deposited banks and islands. Such river-bed *khair* forests seldom show any natural regeneration, as they are liable to be washed away by floods, consequently the trees can be freely felled whenever of marketable dimensions for *kath*-boiling. The new growths springing up spontaneously on fresh silt-deposits require no treatment except protection against grazing, as they soon thin themselves sufficiently, and need to be kept fairly dense in order to prevent erosion of the soil. In Burma the growth of the *sha* tree, yielding the dark-coloured wood, is more usually sporadic than gregarious, though in some of the forests of the Prome and Thayetmyo districts, and in the southern part of Upper Burma, in the zone having an average rainfall of from about 40 or 45 to 55 or 60 inches a year, it forms a considerable proportion of the trees found in certain localities. In these districts cutch-boiling forms an important rural industry, and in years of scanty rainfall additional facilities

are offered for this, in order to reduce the pressure upon the poorer agricultural population. So far as cutch-boiling is concerned, *sha* trees are marketable as soon as they are a foot in diameter, but felling is usually limited to trees of 4½ feet in girth at 6 feet above the ground, in order to ensure proper regeneration and the maintenance of future supplies. To regulate the manufacture of cutch, many of the best tracts have been reserved, and are worked by area, like coppices in Britain, with a rotation of about 30 years. In such reserves the right of making the fall of timber in the precise locality permitted by the working-plan is sold by auction each year, and the blanks thus formed are sown with seed; but outside these reserves the neighbouring villagers are permitted to fell and boil, after taking out licences for a specific number of trees. Seed-production is abundant, and natural regeneration is prolific, while the tree coppices freely. But, in addition to relying on spontaneous growth, much is also done in the way of sowings to increase supplies in the drier forests where the growth of teak is less vigorous than that of cutch, as is particularly the case in the drier forests where the timber-trees are chiefly associated with small kinds of bamboos.

The fragrant, yellowish-brown SANDALWOOD (*Santalum album*) is mainly confined to the dry region of Southern India. Its finest growth and development are attained in Mysore and Coorg, where the most oily and heavily-scented wood is found between 2000 and 3000 feet elevation. Its hard, heavy, oily, close-grained, and strongly-scented wood, so well known in the shape of carved boxes, frames, and similar small articles, is largely exported to Europe and Arabia, but most of it goes to China, to be converted into coffins for rich people. It is not a tree of large dimensions, as one of the largest known only measures 66 inches at 5 feet above the ground. The whole of the annual sales of this, the most costly of all the Indian woods per cubic foot, amount to only a little over 2000 tons, having an export value of about £40,000, of which about 1850 tons are produced in Mysore, 100 in Coorg, and 75 in Madras. In Mysore sandalwood is a royal monopoly, and most of the wood brought to market is cut in hedgerows and scrub jungles outside the areas demarcated as reserved forests. The proportion of the valuable scented heartwood is only about one-half of the log, while the unscented sapwood has little or no value. Even the fragrant sawdust or powder, used for distilling the sandalwood

oil employed for perfumery and medicinal purposes, sells at the wood depôts for from £27 to £33 a ton. The tree is chiefly propagated by means of birds, which eat the fruit and drop the seed from the branches where they perch. Here it germinates in the shade, usually coming up in wisps of a tree or two among bushes, through which it gradually pushes its way, though more quickly, of course, with artificial aid, in quest of the light necessary for its proper development as a tree surrounded with scrubly vegetation. Thus, if carefully protected against grazing and fire, it can be made to extend itself naturally on suitable land, its favourite situation being on a red and rather stony soil; and this method of cultivation, combined with judicious management of the existing forest areas, gives better promise of good future supplies of first-class wood than plantations are ever likely to yield, as the latter have proved unduly expensive and not really satisfactory in other respects. Hence, the most that is now done in this way is to dibble in seed in suitable places under the shade of other trees, and in prepared patches in clumps of bushes and scrub jungle. Planting in the open seems to fail invariably, as the seedlings require some little protection against the scorching power of the strong tropic sun. Its rate of growth varies considerably according to the given local conditions as to soil and climate, but old trees examined in Mysore have been found to give an average of a little over 9 annual rings per inch of radius. The system of working adopted in Mysore is to fell the trees at the age of 40 years, 8 inches being estimated as the average growth in girth per 10 years, and the minimum size of the mature tree being taken as 32 inches in girth at 4½ feet above the ground. In the sandalwood forests of Madras, selection-fellings are annually made over one-tenth of the area, all dead and dying trees being removed, as well as all mature trees above 32 inches in girth, and the roots of the same.

The RED SANDERS (*Pterocarpus santalinus*) of Madras has the least extensive distribution of any of the important Indian trees, as it is confined to an area of about 6000 square miles in and around the Cuddapah district, where the annual rainfall is only about 42 inches, and the shade-temperature varies from 70° to 120°. Its extremely hard and heavy wood, of an orange-red colour when freshly cut, but deepening to a claret-red or almost black, are highly prized as house-posts, often being richly carved in the houses of the rich, and for ploughs and other

agricultural implements. Twenty years ago old dry pieces and seasoned rootwood were largely exported to Europe (over 15,500 tons, valued at £37,000, having been shipped in 1882-83), where this "redwood" was largely used in dyeing, the red colouring principle being the *santalin*, soluble in ether and alcohol, but not in water. Dissolved in water it dyes silk a beautiful salmon-pink colour. Perhaps owing to want of suitable old-seasoned wood, but more probably owing to the discovery and manufacture of cheaper and gaudier artificial dyes, the export of Indian redwood (as of other natural dye-stuffs) has fallen off very considerably, and is now of little value. But large quantities of the wood are used for carving and other ornamental purposes, as well as for furniture and carpentry, and the timber is in considerable local demand. It is a pretty tree, with a tall, straight stem, and a high-set compact round crown of dense foliage, though, curiously enough, its leaves are impatient of the shade of other trees. It seeds in February and March, and natural regeneration from seed is easy, although, as in the case of teak and sál, and many other of the best timber-trees of India, the new shoots are apt to die off year after year until the increasing roots are able to throw out a shoot strong enough to resist the withering effects of the fierce sun and the scorching winds of the hot season. It also reproduces itself well by means of coppice-shoots and root-suckers. It grows best on the northern and eastern slopes of low ridges and spurs, on the stony soil of which the isolated poles of red sanders rise here and there above tufts of scented lemon-grass. The natural forests in the home of this tree are now being carefully protected against fire and grazing, while plantations have also been formed to provide increased supplies for future use. Planting is usually done with seedlings raised in small loosely-woven bamboo baskets, which are inserted into holes of suitable size dug in the ground, and are regularly watered during the dry season. Few observations have been recorded as to either its rate of growth or as to its attainable dimensions. Gamble mentions a plantation made in 1865, which showed in 1883, at 18 years of age, an average height of 40 feet and girth of nearly 18 inches, with an average annual increment of nearly 3 tons per acre; but this is probably less rapid than its growth in the open natural forests.

Each of the Indian provinces, as indeed almost every tropical and subtropical country, has as its own peculiar "ironwood," some

hard, heavy, and durable kind of timber. The chief of the Indian ironwoods are the PYINGADO (*Xylia dolabriformis*) of Burma, the NAHÓR of Assam, or NAGESÁR of Bengal (*Mesua ferrea*), and the ANJAN (*Hardwickia binata*) of Southern and Central India. The Burmese ironwood, PYINGADO, occurs abundantly in some parts along with teak, many other deciduous trees, and bamboos, in the dry forests of the lower hills, and is, next to teak, the most important of the timber-trees of that province. Under favourable conditions as to soil and environment, it grows to 90 or 100 feet in height and 9 to 12 feet in girth, but on poor soil and in uncongenial situation (as in Arakan) it remains dwarfish and stunted—a description applying also to it in Godavery and the western coast of Madras, where it is also indigenous. The reddish-brown to dark brown, close and cross-grained, very hard and heavy wood is exceedingly durable, and is much prized and largely exported for railway sleepers, the Burmese wood being, in this respect, much finer than that grown in Southern India, owing to the greater amount of resin contained in the former. Extracts made from the wood possess good tanning properties, and it is quite possible that the sawdust and waste wood in conversion might easily be turned into a profitable article of export. It produces seed abundantly, and seedlings spring up readily where the forests are protected from fire. The ANJAN of the dry forests of Southern and Central India, which also extends northwards into the southern portion of the United Provinces (and is found also in tropical Africa), is likewise a deciduous tree, but is to be found growing more or less gregariously in isolated belts and patches of various extent, and usually on sandstone. Its extremely hard and dark-red wood, streaked with black and often having a purple tinge, has, again like pyingado, its pores filled with resin, which tends to increase its weight and durability. It is extremely durable, does not warp, and is not liable to split, while it is perhaps the hardest and heaviest of all the Indian woods. It is in all respects well suited for sleepers, bridge-construction, house-building, and ornamental work, but it is too hard and too difficult to work to be much in favour among the natives. It seeds freely, regenerates itself easily, and coppices well; but the seedlings and the shoots thrown up by the roots are killed off year after year by hot winds and fires, until finally one is found strong enough to withstand these hindrances to normal develop-

ment. The NAHÓR or NAGESAR of Assam and Bengal, on the other hand, is an evergreen tree, with beautiful foliage and fragrant white flowers. Though its true home is in eastern Bengal and Assam, it extends far southwards into Burma, where it is known as GANGAW, and venerated as a semi-sacred tree. As it has been foretold in the Buddhistic sacred writings that the sixth and next Buddh will make his appearance under the shadow of a *Gangaw*-tree (as the fifth and last Gaudama attained the supreme knowledge of the Law while reclining under the sacred *Banyan*), it is to be found planted near monasteries all over the country, ready for the great event, should any of the monks happen to be the embryo Buddh. The dark-red and very hard and heavy wood is an exceedingly strong and endurable kind of timber; and it is only, as in the case of Anjan, its great weight, and its extreme hardness, and the difficulty of converting it with native tools, that accounts for its comparatively small use. It takes a fine polish and, having a beautiful dark grain, is suitable for high-class furniture and decorative purposes in Britain, much in the same way as the PADAUK (*Pterocarpus indicus*) of the Andaman Islands—which, by the way is also obtainable of finer colour, texture, and dimensions in some of the deciduous forests of Burma (Toungoo district).

Besides the valuable kinds above described, the MAHWA-TREE (*Bassia latifolia*), growing scattered throughout the deciduous forests of Central India, and extending thence south-westwards to Kanara, and northwards to Oudh and Kumaon, and also occurring in Upper Burma, is one of the most important trees in the districts to which it is indigenous. Its value depends less, however, on the excellence of its hard, smooth, durable, red wood than on the edible qualities of the sweet, fleshy leaves of the corolla of its flowers, which, appearing in the hot season during May and June, form an important article of food throughout the forest districts where this tree occurs. The corollas are eaten either raw or cooked; they are used for making sugar; and a coarse and highly-intoxicating spirit is distilled from them, the odour of which is so strong and so unpleasant as to be noticeable at a long distance from the still. The average yield of corollas from a mature tree is about 200 lbs., which sell for about half-a-crown when collected. When eaten, they are mixed with other food, or with seeds and leaves of other plants, and

they taste somewhat like pressed figs. The outer coating of the fruit is also edible, being either eaten raw or else cooked as a vegetable, and the inner coating is dried and ground into meal; while a yellowish-green, butter-like oil, which soon becomes rancid in that hot climate, is expressed from the kernel, and used by the hill-tribes or sold for soap-boiling. In this respect the mahwa resembles the shea tree (*Bassia Parkii*) of Western Africa, the "shea butter" obtained from which Mungo Park, the famous traveller, declared to be whiter, firmer, and richer in flavour than the best ordinary butter he had ever tasted, with the additional advantage of keeping fresh and sweet for a twelvemonth without any admixture of salt. On account of the edible value of its flowers and fruit, the mahwa-tree is worked with a view to these, rather than for its fine timber, and special provisions are accordingly made for the protection of the oldest and best trees growing in forests worked under a systematic plan. It seeds freely, and the fresh seed germinates well; but, being oily, its germinative power soon passes away. It is much cultivated either in avenues along road-sides, and in "topes" or clumps by itself or along with mango, and in such places it often sows itself spontaneously.

Nothing like the whole of the areas throughout which these chief timber-trees of India occur have been brought under the direct control of the Indian Forest Department, although the area at present administered by it amounts to close upon 120,000 square miles, over two-thirds of which, or about 81,000 square miles (amounting to about one-twelfth of the total area of 945,000 square miles of British territory), have been reserved and legally settled as permanent forest estates to be administered for the benefit of the people, and of their agriculture, and of the finances of the Indian empire. These great forest estates already yield a net annual income of about £500,000 a year, after payment of all charges directly or indirectly connected with the working, maintenance, protection, improvement, and increase of the marketable products they supply, and leaving out of consideration enormous quantities of timber, fuel, bamboos, grazing and grass, thatching material, etc., supplied free from payment to villagers resident in the vicinity of the reserved forests. This net revenue, moreover, is steadily expanding under the careful husbandry of the well-trained and hard-working corps of officers forming the Indian Forest Service.

XVI. *Notes on Indian Forestry in* 1905.

By the HON. EDITOR.

The latest Review of Forest Administration in British India enables one to form some idea, though only an imperfect one, of the vast importance of the woodlands to that empire. The outturn in timber and fuel was 246,000,000 cubic feet, while 323,000,000 bamboos and over £300,000 worth of minor produce were extracted—about one-third of all of which were extracted free of charge by right-holders or grantees living in the vicinity of the forests, to a total value of £220,000. Without including any credit for this sum in the accounts, the gross revenue was £1,298,100, the total expenditure £548,147, and the net surplus £749,953.

The work of selecting, "settling" or fixing the legal status, and demarcating the State Forests, is still going on, although this has been vigorously proceeded with for over thirty years. There are nearly 94,000 square miles of reserves and 150,000 square miles of State-managed forests, while 1485 square miles in Burma and Madras form the last tracts finally *settled* as reserves, and 2363 square miles are still under settlement. In Bengal there are 74,000 miles of reserve-boundaries, in Madras 34,000, and in Bombay 45,000, while about 24,000 miles still remain to be demarcated with cairns, numbered posts, etc. The detailed survey of the demarcated forests is also proceeding steadily, as working-plans cannot be formed until maps are available.

The area of reserved forests protected by cleared lines as fire-traces amounts to 36,651 square miles, most of which is patrolled by watchers, although part of this is left without special supervision, with the inevitable result that fires are there not so successfully excluded.

In an agricultural country like India, in many parts of which the forests are the only places where green succulent food is easily obtainable for the cattle during the hot, dry season of the year, grazing is a question of vital importance; and it is therefore satisfactory to learn that year by year the grazing question comes nearer to a satisfactory solution for those concerned. Only about 17 per cent. of the State Forests are at present entirely closed to cattle, and in time of scarcity these would be

thrown open, as was done throughout Central India during the awful years of the last great famine.

There is no country in the whole world where the influence of forests with regard to climate and water-storage is of greater importance, or affects a larger number of human beings than in India. There cannot be the slightest doubt whatever that almost unchecked clearance over vast areas in the past must have contributed very materially towards intensifying the effects of shortage in rainfall during years of weak south-west monsoon currents, and thus aggravating the miseries of the famines thereby caused. Through the reservation of State Forests, the further aggravation of this lamentable condition of affairs is to some extent stayed; but, for any real improvement in such a climatic and economic matter, of vast and ever-increasing importance though it be, Imperial funds and an adequate special establishment would be necessary, as it is almost hopeless that the present Forest Department could possibly cope with such extra work. Indeed, the wonder is that the continuous record of increasing work and expansion in every direction can be so well maintained year by year, as it has been, with the scanty increases in superior and subordinate establishments that can alone be wrung from time to time from the Government. But even although the Indian Forest Department has more than enough of work for the sanctioned staff, the services of many of its officers have been asked for, and have been lent, to Colonial Governments, and twenty are now on "foreign service" in Ceylon, Egypt, South Africa, Nigeria, Malay States, Siam, Trinidad, Mauritius, and other colonies. This is not as it should be, and it is to be hoped that Britain will now soon be able to supply her colonies with forest officers direct from home, in place of India being thus called upon to weaken the staff trained for her own special service.

In the fire-protected areas it has been found that in many cases protection favours the growth and development of inferior trees, and of bamboos, etc., more than it favours the one or more kinds of trees which it is specially desired to benefit; hence improvement-fellings are needed to assist the natural regeneration and the growth of the more valuable kinds of trees. This has unfortunately been very particularly the case with regard to teak in Burma, the timber-tree which produces by far the largest net revenue to the Government of India. "From some circles,"

we are told, "are recorded interesting details of the progress of investigations or of experiments made in the endeavour to ascertain the reason of the failure of teak regeneration in protected forests. So far as these have proceeded, it appears evident that the absence of sufficient light, or the presence of excessive undergrowth, are the retarding causes; but the problem of how to provide, over large areas of natural forest, for the former without inducing the latter is still unsolved."

The maintenance and the increase of future supplies of teak timber are matters of vast importance not only to Burma alone, or to India alone, but also to the whole British empire and the world at large. The natural forests in which teak is indigenous are partly dry and partly moist in character, but the dry forests constitute the most extensive and the most valuable tracts. In their natural condition these are annually overrun by ground fires, spreading from the rice-fields burned over in March and allowed to eat their way along the ground unchecked into the woodlands. These ground-fires entirely consume the dead foliage and debris in the woods, so that the ground is often as bare as it is possible to conceive it, even large logs, which smoulder for days on end and break into flame at night, being often reduced to nothing but a long line of white or greyish ash. On the heavy rains setting in, the soft surface-soil is washed away, and the surface is cleared again by fire in the following hot season; and so on, year after year.

One effect of this is that vast numbers of teak saplings get burned and killed each year, new shoots being thrown up from the root-stock in the succeeding rainy season, until by some chance the shoots escape scorching and so grow into poles with bark thick enough near the base to resist the scorching of the ground-fire. This fortunate condition is supplied by the flowering and regeneration of the bamboo undergrowth at irregular intervals of from about ten or fifteen to over fifty years, according to the species of bamboo prevailing locally—because for two or three years after the seeding of the bamboo a dense growth of moist thicket springs up, impenetrable even to the fire. One consequence of this is, that the natural age-classes among the teak and the other trees forming the overwood vary according to the dates at which the seedings of the bamboo underwood have taken place.

In the most important teak-tracts of Lower Burma, the slopes

of the Pegu Yoma or hill-range between the Irrawaddy and the Sittang rivers, the largest and most important tracts are those in which the *Kyathaung*-bamboo (*Bambusa polymorpha*) prevails, and which may be put down as well over 2000 square miles in this part of Burma alone. The last seeding took place about 1853, immediately after the annexation of Pegu. The result of the seeding was that an immense natural increase took place in jungle-fowl, rats, etc., owing to the vast abnormal increase in food; and this plague of rats in the following year, when the bamboo seeds had rotted or germinated, entirely destroyed the rice cultivation of the nomadic hill-tribes, so that famine ensued, and was followed by an epidemic of small-pox. Unless Government takes adequate precautions, this will again be followed by similar results when the *Kyathaung*-bamboo next seeds; and its flowering might easily have taken place at any time within these last ten or twelve years. Fortunately it can be foretold one year in advance, because no new shoots are thrown out during the year before flowering, the reserve-nutrients being stored by nature for the supreme effort of seed-production, after which the bamboo-crop dies and rots; and this phenomenon occurs simultaneously over all the area dominated by this species of bamboo, although sporadic flowering of smaller kinds is frequent, as in the case of the *Tin*-bamboo (*Cephalostachyum pergracile*), which ranks next to the *Kyathaung* in importance and distribution.

As the next flowering of the *Kyathaung*-bamboo must probably mean sylvicultural possibilities on a vast scale, it seemed to me (while Conservator in charge of the Pegu circle in 1895) that a scheme should be considered and adopted for coping with the work when the time came, and for determining beforehand what could be done to utilise the circumstance and to provide work and food for the hill-tribes, in order to save them from the danger of famine and subsequent epidemics,—because efficient administration should, I thought, provide for such matters beforehand; and unless a definite scheme of operations were considered and prepared for action, it would be impossible to utilise the grand opportunity economically and to the fullest extent possible, since, of course, intensive operations cannot be carried out over the whole of the area affected. This proposal was pooh-poohed by the then *officiating* Inspector-General, but it has recently, I understand, been revived with more satisfactory results.

Meanwhile, however, the practical effect of the fire-protection carried on continuously for from twenty to thirty years has, in many parts, shown quite a different result from what was expected; and one very important circumstance has now been noticed as frequent, which was never observable in former days, during the twenty years (1876-96) in which I spent many months of each year in the forests where the *Kyathaung*-bamboo formed the prevailing undergrowth. But that was the time when fire-protection was only being introduced, or had merely been recently introduced; and I can safely assert that if what has now been noticed as common had then already taken place, it could hardly have failed to be observed. The important physiological result of the influence of fire-protection on the reproductive power of the two chief species of bamboos has thus been described by a careful observer, Mr Troup:—

"It is a fact which has, I believe, been noticed by many officers, that in bamboo areas, at anyrate of *Kyathaung-wa* and *Tin-wa*, which have been fire-protected for a long time, an undergrowth of smaller-sized bamboos of the same species tends to form. The precise mode of origin of this undergrowth, and its connection with the older bamboos, I have not ascertained."

It seems to me very probable that examination will show this new and lowest tier of undergrowth to be suckers thrown up from the rhizomes; and if this should prove to be the case, the importance of the fact is great, *because it will probably mean that there will, if this process continues in all such places, be no general flowering of the Kyathaung, as happened in* 1853, and that consequently there will be no opportunity for natural regeneration of teak on a vast scale (assisted by artificial means) such as has never before occurred. Nature, in effecting her objects, always operates along the line of least resistance; and if the conditions artificially created by fire-protection enable her to regenerate the *Kyathaung* by means of suckers, she will certainly not undergo such an otherwise unnecessary physiological disturbance as is indicated by the non-production of the usually annual crop of shoots in order to store up the nutrient-reserves for accomplishing flowering and seed-production in the following year—a supreme effort involving a process of utter exhaustion, followed immediately by the death and decay of all the existing halms. And if such a change takes place (on any extensive scale) from what obtained before the introduction of fire-protection, then, at

any rate, further difficulties will be placed in the way of the regeneration of teak, although Mr Troup's pessimistic conclusion "that we are most certainly exterminating our teak by fire-protection," is, no doubt, far too sweeping an assertion, even although based on the fact that fewer teak seedlings and young poles are to be found in fire-protected areas than in otherwise similar but non-protected tracts.

Fire is certainly a most useful agent to clear the ground for the reception of the teak-seed at the time of the seeding of the bamboo—and even at other times it may often again be a powerful and beneficent agent, when applied under proper control; and after a crop of young teak seedlings is formed, fire-protection is undoubtedly beneficial until the bark of the young poles is able to withstand the destructive action of annual fires. Later on, one can quite easily conceive fire-protection tending to benefit inferior kinds of trees and bamboos in greater ratio than it benefits teak, and thus of favouring the natural regeneration of these at the expense of the teak, and therefore making *a normal series of teak of all age-classes on one and the same area* impracticable, and perhaps even impossible. But is such a grouping together of age-classes an actual necessity? Or is it under such given circumstances either really desirable or at all practicable? These are questions that cannot be answered off-hand by a simple "yea" or "nay." Many of the younger officers, whose experience may have been chiefly in forests already managed for the last fifteen to twenty years under a working-plan (the oldest dates only from 1885), can perhaps have only an imperfect idea of the great extent to which mature and maturing teak trees in the natural forests used to be badly damaged and hollowed in the butt and far up into the most valuable part of the stem by the destructive action of fire; for all such trees were to be cleared and extracted except where of small value as timber and necessary for seed production. But it is perhaps just as unwise to generalise from one or two well-recorded observations as it would be to jump to a conclusion from the expression of mere general impressions unsupported by accurate data; and in any case, before the Local Government and the Government of India can be approached with any well-considered scheme for their acceptance concerning such an important matter, it would seem very desirable to make further investigations carefully and systematically. Certainly the pre-

sent officers have opportunities of comparison which did not exist twenty, or fifteen, or even only ten years ago.

In the Indian forests there are, of course, many noxious insects and fungous diseases which are destructive to the more valuable kinds of timber, but it is only of recent years that officers of the Department have been able to bestow much attention on determining the pests, and observing and recording their life-history—work in which they have received invaluable assistance from the officials of the Indian Museum in Calcutta.

Much and widespread damage is frequently caused by the caterpillars of two kinds of *Pyralides*, micro-Lepidoptera (which were determined about 1889), the result being an almost total defoliation of the teak both in plantations and in the natural woods, when the spring flush of leaves comes out. The increment from April to July is thus lost, but fortunately a fresh flush of foliage comes in July, and there is no second brood of the insect to destroy it—otherwise the effect might be very serious in young plantations.

Another insect that does much more lasting damage to the teak is the insect which often riddles growing stems with what are, in Burma, called "bee-holes," resembling the borings made in European timber by the caterpillars of the goat-moth (*Cossus*), the wood-leopard moth (*Zeuzera*), and the wood wasp (*Sirex*). As timber thus damaged is outside the Admiralty specification, this insect is (as yet) the most noxious enemy of the teak; and it is interesting that, as the first step towards the possibility of preventing its attack, this has now been discovered to be a large brown moth, *Duomitus ceramicus*, with long and narrow wings, having an expanse of over 4 inches; but its life-history has not yet been ascertained definitely. Among minor insect pests, the *Chermes abietis-piceæ* produces galls on the Himalayan spruce (*Picea Morinda*).

As regards parasitic fungi, it will interest British foresters to learn that the pine-canker fungus, *Trametes pini*, occurs as a common disease on poles of *Pinus excelsa* in the Punjáb Himalayas, throughout the area in which the deodar is the tree of chief value. In one infected area of 181 acres, with a 40-year-old crop, near Simla, a dense pole-wood was found, "diseased beyond hope of recovery." To obtain some reliable data, a 1-acre sample plot was carefully counted in one of the best-stocked parts, and it was found that "out of 693 trees no less than 203, or say 30 per cent.," showed

obvious signs of the disease in the shape of sporophores, while no doubt at least other 10 per cent. were also infected, though not yet showing externally the fructifications of the fungus.

To those who think of India as being only a hot country, instead of (as it actually is) a vast empire with all varieties of climate, from very arid to extremely wet, and from excessively hot to intensely cold, it will be surprising to learn that in the forests of the *dún*, or belt fringing the southern outliers of the Himalayan range, "about 75 per cent. of the forest-clad area of the *dún* (in this instance the Dehra Dun, where the Imperial Forest School is located) suffered considerably from the abnormal frosts during January and February of this year. . . . Poles from 1 to 2 feet in girth have been killed to within 5 to 15 feet from the ground, while those under 1 foot in girth have been killed to within a few feet from or down to the ground itself. . . . The injuries that the forests have sustained must represent the loss of at least ten to fifteen years' growth." Coppice areas have suffered severely, though new stool-shoots have been flushed; but young seedlings, in fairly dense forest, seem, fortunately, to have escaped.

Of other parasitic diseases of conifers common to Europe and India, *Fomes annosus* attacks the deodar in the Himalayas, and one of its characteristic features there is its extension by rhizomorphs, while these organs have not yet been described for the same fungus in Europe, either because they do not exist, or because they have hitherto escaped attention. But the majority of the parasitic diseases in Indian forests are probably entirely different from those in Europe, though not much knowledge on the subject has as yet been acquired. These matters are now, however, being gradually investigated by the cryptogamist to the Government of India, along with similar questions relating to the fungous diseases affecting agricultural and other crops.

XVII. *Some Recent Developments in Swedish Forestry.* By JÄGMÄSTARE ELIS NILSON, Kolleberga, Ljungbyhed, Sweden.

In this short article I propose to set forth and explain some of the latest reforms and improvements which have been introduced in the working of the Swedish forests, and which will be of the greatest importance in their preservation and development; and in doing so I trust that, seeing that some such reforms are also much needed in Scotland, I have touched upon a matter which may be of sufficient importance to create interest amongst the readers of the *Transactions*.

1. LAW RELATING TO THE MANAGEMENT OF PRIVATE FORESTS.

This law, the passing of which has for many years been the object of those whose wish it is to preserve Sweden's forest stock, and to put an end to reckless destruction of her forests, came into force on 1st January 1905. Stated briefly, the law seeks to attain the following object:—On forest ground belonging to private persons, the cutting of timber is not to be carried out in a way detrimental to natural regeneration, nor is the ground, after the cutting of timber, to be treated in such a way that natural regeneration will be endangered. The object of the law, therefore, is not to reduce the cutting in the sizes or age-classes as practised at present, nor does it interfere with the right of the owner to work his woods in the way he thinks best, provided he promotes regeneration, when it is necessary, immediately after the cutting of the timber is finished. In so far as it relates to the woodland soil, the law prohibits the burning of the cleared ground in such a way as to cause deterioration of its quality; and, again, should a young, non-seedbearing wood be spoilt through over-thinning, so that the ground would run the risk of deterioration, or of becoming wild, such a wood must at once be underplanted.[1]

In order to ensure that the regulations for the working of the

[1] Such a law could never be applied in Britain. Neither political party would dare to bring in such a Bill, unless this at the same time provided State-aid for the improvement of existing woods and plantations to landowners desirous of trying to work their woodlands on purely business principles. And any such law could only be permissive, but not compulsory.—HON. ED.

private forests laid down under this forest-law may not be neglected, a Board of Directors, to whose charge the enforcement of these regulations is entrusted, is appointed in every Provincial Assembly (Landsting), and these Boards have the assistance of a forest officer and as many provincial foresters as may be necessary. Besides these provincial Boards, there is appointed in every parish a Forest Committee, whose duty it is to control, and in every possible way encourage, private forestry.

2. Protection of Nature and its Chief Features of Interest.

Thanks to the sympathy with which Professor Conwentz's well-known endeavours in connection with this matter have been everywhere received, a new law has also been adopted in Sweden, the object of which is to protect typical parts of native forests, original trees, the forests at their limits of altitude on the mountains, and all kinds of trees at the limits of their distribution, and, what is more especially to be noted, the protection of the interesting and useful forest animals. In this way almost all our insectivorous birds are placed under protection of the law; but, as most of the birds are migratory, such protection will be wholly effective only when the countries of southern Europe have adopted correspondingly wise and humane regulations.

3. Institute for Experimental Forestry.

Since 1902 we have had the good fortune to possess an institution, based on the same lines as the German and Austrian institutions of the kind, for the promotion of scientific research and experiments in forestry, and for the production of essays and reports on forestry matters. This institution, which is situated in Stockholm, is maintained at the expense of our Government, and is under the direction of an experienced forest officer, assisted by other forest officers and a staff of scientists; and although the institution is as yet in its infancy, the foundations of very important experiments in connection with our country's forests have already been laid.

4. Purchase of Woodlands by the Government.

The purchase of woodland by the Government has been going on for some years, and in 1904 about 290,000 hectares, or

716,000 acres, were bought, at an average price of about 26s. per acre.

5. Sylviculture.

Regeneration by self-sowing from mother-trees has, especially in the northern and greater part of Sweden, to be adopted to a very large extent, chiefly on account of the immense areas which have to be dealt with, the relatively thin population in these regions, and the short spring-time. Such natural regeneration is greatly favoured, and not least, perhaps, because of the good results which we have found it to give when properly arranged. Besides this, however, artificial regeneration by hand-sowing and planting is carried out on a very large and constantly increasing scale, as much as about 40,000 kilogrammes (over 88,000 lbs.) of seed having been sown, and from 40 to 50 million plants having been planted out this season.

The above remarks will, I think, show that in Sweden interest in forestry has greatly increased, and that the forest stock of the country, instead of decreasing, will, on the contrary, increase in a gradual but certain way, and that it will be kept up to the standard required by the economic conditions of the country.

XVIII. *Belgian Forestry in some of its Aspects* (with Photographs). By A. T. GILLANDERS, Forester, Alnwick Castle, Northumberland.

The following notes, gleaned in the course of the Royal English Arboricultural Society's Excursion to Belgium in August 1905, have been put together in the hope that they may be of interest to the members of the Royal Scottish Arboricultural Society. The Excursion party, under the guidance of the President of the Society, Professor W. R. Fisher, left London on August 12th, and travelling *via* Harwich, Antwerp, and Liége, reached Spa, in the province of Liége, on the following afternoon.

Compared with those of some other Continental countries, the forests of Belgium present a marked contrast. In France, for example, one finds mature woods in abundance, but there are few of these in Belgium. The Belgian forests are as yet only in the making; in fact, they were only brought under public control by the *Code Forestier* in 1854. And when it is remembered that as a nation Belgium has enjoyed independence for only seventy-five years, that it is only ninety years since the battle of Waterloo was fought, and that many of the great men who were associated with that battle were rewarded with woods which they sold, and thus denuded the country of most of its finest timber, this state of affairs is not at all surprising. But the Belgians are making up leeway, and under their capable forest administration are rapidly placing their forests on a more satisfactory footing.

In Belgium the woods belong to the State, to Communes, public establishments, and private owners. The State, of course, manages its own woods, and it also demands certain rights of control over communal woods; and though it does not interfere with private owners in the management of their woods, it gives them the advice of its forest officers, and the assistance of its forest guards when required, in order that all the woods, public and private alike, may be managed on the most approved principles, and thus become a great national asset.

As regards the distribution of the woodlands amongst the various owners, the following statement, taken from the guide-

book which was prepared in anticipation of our visit, will show in what proportions they are held:—

	Acres.
State woodlands, ...	62,600
Communal woodlands, ...	395,455
Public establishments' woodlands, . .	17,380
Private woodlands, ...	828,300
Total, . .	1,303,735

At the forest of the Hertogenwald, near Verviers, which was visited on 14th August, a very successful experiment in the planting of spoil-heaps was seen. After trying almost every likely species of tree, it was discovered that the white alder (*Alnus incana*) was the best for the purpose, inasmuch as it rooted freely, and wherever the roots came near the surface young suckers shot up round the parent plant, and formed a sort of copse, thus binding the heap together. At planting, each alder plant received a double handful of soil, carried to the spot in a basket. Very large heaps of loose stones lying on the hill-side had also been planted in this way with birch.

The forest of the Hertogenwald is divided into three zones of altitude. In the lower zone, which has an altitude of from 770 to 1300 feet, the soil rests on the Lower Devonian rock, and is permeable and fairly fertile. The crop is usually coppice-with-standards, but it is intended ultimately to convert the whole of this portion into highwood. In order, however, to bring the whole of the woods into line with the working-plan, it is proposed to take two more rotations of thirty years' coppice-with-standards from one section of this zone. This zone is very liable to injury from fires, and in order to make the heathy ground of which it is composed less liable to danger of this sort, the oak standards have been underplanted with beech; but where the heather was very rough, Scots pine has been thickly planted, and on the highest altitudes spruce has been used, as the latter species is not so liable to damage from heavy snowfall as Scots pine. These thickets of Scots pine and spruce come in very useful for mining timber, which is always in great demand in Belgium. In England the working of each ton of coal involves a cost of sixpence for timber, but in Belgium the cost is tenpence per ton. In the middle zone, the altitude of which is from 1300 to 1590 feet, the soil is more or less of a clayey nature, but, sylviculturally, the

conditions are practically the same as those of the lower zone. In the higher zone, the altitude of which is from 1590 to 2160 feet—it is, in fact, the highest part of Belgium—we were shown some very interesting work. In many parts the crop consists of pure spruce, but in other parts it consists of birch coppice-with-standards. On arriving at what appeared to be the summit we left our conveyances and made a short tour on foot. On our right we had, considering the altitude, a very fine crop of pure spruce, and on our left bare ground of a very poor quality. The flora is sub-alpine, *Salix repens*, *Betula pubescens*, and a species of large-stemmed bilberry being conspicuous. The country looked a typical waste—what seemed an ideal field for the enthusiastic advocate of the planting of waste land to try his hand upon. But under similar conditions our method of dealing with a subject such as this would, as a rule, be somewhat different from what we saw here. In most cases we would plant without any preparation in the way of shelter, with the result that, as a rule, the venture would end in failure. Not so, however, with the Belgian forester. He tries first of all to form a barrier to the prevailing winds, and thus prepare his land for his crop of trees. Here the planting had been commenced at the bottom of the hill, so that its sheltering influence had been gradually extended upwards. At the highest part was a large, damp, mossy waste, covered with grass of a very inferior type, notably *Nardus stricta*, and this was now being dealt with in the following manner:—At intervals varying from 13 to 33 feet apart, a swathe is mown with the scythe, and along this a trench or drain is then cut by two men who follow the scythe-man. After lining out the drain, one man cuts the turfs and the other pulls them out, and in doing so he pulls two turfs to one side and two to the other. In the act of pulling, the turfs are turned upside down, and laid close together, and in this position they are allowed to lie for two years. At the end of this period planting is commenced, and is done in the following manner:—A man with a special auger-shaped spade or planting-iron cuts a hole clean out of the turf after the manner of cheese-testing. A woman who follows places in each hole so formed a spruce plant of a size about equal to our 2-year–2-year transplants, and as each plant is inserted a double handful of imported soil, to which a small quantity of basic slag has been added, is placed round its roots, and the remainder of the hole filled up

with the excavated peaty soil. The basic slag costs about 1s. per 1000 plants, and as the cost of the spruce is put down at 6s. 8d. per 1000, and the planting at about 5s. per 1000, the total cost is 12s. 8d. per 1000. The spruce are planted at about 7 feet × 5 feet apart, and thus we have a row of spruce plants on each side of the drain, and a vacant space between the drains. Nothing further is done for ten years, and at the end of this period the intervening spaces are planted with pure spruce, according to the customary distance of 3 feet apart. When this planting up comes to be done, great benefit is derived from the shelter produced by the double row of spruce planted ten years in advance, and, in addition to these double rows of spruce, strips of common spruce mixed with Weymouth pine (*Pinus Strobus*), white spruce (*Picea alba*), red spruce (*Picea rubra*), Swiss stone pine (*Pinus Cembra*), white alder (*Alnus incana*), or birch, at 4 feet apart, are often planted on the south and west boundaries, which are exposed to gales, as wind-breaks. In this we had an excellent object-lesson in the way of planting large tracts of exposed waste land by forming barriers against the prevailing winds with a hardy species, and by producing shelter by means of rows of hardy shelter-trees planted in advance of the main crop.

On Tuesday, 15th August, the party left Spa for Rochefort, the communal woods of which town were to be next visited. The day was a great national holiday, consequently a long time was occupied in the railway journey; but to those of us who were fortunate enough to find ourselves in the same compartment with our guide, Monsieur Crahay, the long journey proved rather an advantage than otherwise, for we received much interesting and valuable information from him regarding the geology and sylviculture of the country through which we passed. The advantages of planting belts of hardy species in advance, and afterwards filling up with the crop proper, were again and again demonstrated; and one of the most interesting items of information which M. Crahay had to impart to us was that, in Flanders, it paid very well to plant Scots pine at 1½ feet apart, and clear-cut the crop for fuel at ten or fifteen years of age. At many places *en route* we saw large stacks of faggots, such as one often sees in dealers' yards in Kent; and these, we were informed, are used in the roofs of the mines for preventing small stones from falling down.

The geology of the locality round Rochefort is somewhat varied. In some parts the formation is limestone, in which are large underground caverns, and consequently the overlying soil is very dry and poor; but on other parts the geological formation is different, and the soil is more fertile and the crops better. In the communal woods the original intention was to form hardwood plantations, and the ground, which, by the way, is rather hilly, was accordingly stocked with broad-leaved species; but the result was a complete failure, and Scots and Austrian pine had to be planted as a preparatory crop. Here we got some valuable information regarding the way in which hilly ground, covered with rough herbage, is prepared for planting. First of all, the ground is heavily stocked with sheep, which are hand-fed in order to make up for deficiency in their natural food. Two or three years' grazing with sheep results in a change from rough herbage to fine pasturage; and to still further improve the soil, it receives a dressing of 8 cwts. of basic slag per acre while the ground is being grazed. When the planting of pines comes to be done on this improved land, small plants can be used, say 2-years' seedlings, or, better still, 1-year–1-year transplants. These are planted about a yard apart with the ordinary dibbling-iron; and in connection with this, it has been shown that planting in September and October gives the best results, as a certain amount of root-action sets in before winter, and there are consequently very few deaths. The ground is very stony, and the stones are often utilised for the purpose of checking the escape of moisture from the soil, by being placed, one on either side, over the roots of the plants. Sowing seed had been tried, but had resulted in failure; and, so far as experience had gone, sowing, to be successful, must be done in spring, while the best results from planting were got when this was done in autumn.

Once the crop is established it is left pretty much to itself for the first twenty years of its growth, dead or dying trees only being removed where necessary. At thirty years of age a slight thinning is made, with the object of clearing small spaces, at more or less regular intervals, for the insertion of beech plants. In addition to beech, other broad-leaved species, such as birch, willow, blackthorn, etc., are encouraged to grow, and thus, when the final cutting of pines is made at forty years of age, there is a fairly good sprinkling of hardwoods in the ground, which act as nurses to the oak or other hardwoods which are then planted.

It should be noted that a mixture of Austrian and Scots pine is considered a very good one, inasmuch as the Austrian pine retains its leaves for four years, thus giving greater shade, and the dense foliage produces a considerable amount of humus, thus protecting the soil from drought.

From Rochefort the party drove to St Hubert, and on Wednesday morning they left the latter place and journeyed by tramway to Poix, in order to visit the Mirwart estate of Mr J. P. von der Becke, of Antwerp. On the journey from St Hubert to Poix, a curious combination of sylviculture and agriculture, known as *Sartage*, was seen. The sylvicultural crop was birch coppice-with-standards. When the coppice is cut and cleared away, all the rubbish left lying on the ground is burned, and this is done in two ways:—(1) The rubbish is raked into heaps, burned, and the ashes spread, or (2) it is fired as it lies broadcast on the ground, the fire being made to run along the surface. The cleared ground is then partially cultivated, and sown with rye, 8 cwts. of basic slag per acre being added prior to the sowing of the rye. (See Fig. 1.) This cultivation is done for one year only in communal woods and for two years in private woods.

The domain of Mirwart has changed hands several times, and the following extract from a statement regarding its history and management, prepared by Dr Schlich, which occurs in the guide-book is interesting:—

"The history of the domain of Mirwart goes back to the ninth century, when the estate belonged to a Count of Hainault. It changed hands repeatedly, and one of its proprietors was Adolphe de la Marche, known as the Wild Boar of the Ardennes, and referred to in Scott's grand novel of *Quentin Durward*. The estate is now only a fraction of what it was formerly. It was purchased in 1891 by Mr J. P. von der Becke, of Antwerp, and Dr W. Schlich, of Coopers Hill. In 1903 the latter sold his share in the property to the family von der Becke, to whom the estate now belongs.

"The area is as follows:—

Woods, ...	2875	acres.
Fields and meadows, . .	425	,,
Total, . .	3300	,,

[*Photo, F. S.*

Fig. 1.

[*Photo, A. C. F.*

Fig. 2.

[*Photo, A. C. F.*

Fig. 3.

[*Photo, A. C. F.*

Fig. 4.

"Dr Schlich has managed the woods of the Mirwart estate from 1891 until now. He found by far the greater part of the area stocked with an irregular crop, consisting of oak and beech, with a moderate amount of hornbeam, sycamore, birch, aspen, and ash. Originally the method of treatment had been coppice-with-standards, but owing to haphazard management, continued during a long period of time, some parts had grown up into high-forest, others were still coppice-with-standards, and others again coppice only.

"The latter consisted of very old stools, producing only feeble shoots. Throughout, the woods were incompletely stocked, and contained a large proportion of inferior trees, which should have been cut out before, instead of the better class of trees.

"The annual increment was very small, and the value of the underwood almost nil. Under these circumstances, Dr Schlich decided on the following system of management:—

"(1) Reservation of all fairly good stems, unless absolutely mature.

"(2) Removal of all inferior trees.

"(3) Filling up the woods with a species which would yield a quick return. As to the latter, the choice lay between Scots pine and spruce, since experience has shown that larch always became quickly diseased to such an extent that it was practically valueless."

The chief interest of Dr Schlich's management lies in the fact that it showed what can be done in improving existing woods by taking things as they are, and making the most of them. The woods are divided into compartments, and each compartment is treated on its own merits. In some places the crops have been underplanted with spruce.

In these woods the intention is to have ultimately the following stocking:—

(*a*) Groups of oak on good soil.
(*b*) Groups of spruce on inferior soil.
(*c*) Beech on the rest of the area.

On Thursday, 17th August, the party visited an estate which formerly belonged to the Abbey of Villers la Ville, but is now the property of Monsieur Boël, senateur. The first object-lesson we saw here was some planting which had been done on heath

land. The plants were planted in rows, about 3 feet apart, and in the following way:—A straight track was dug, about one spade in width and one in depth. Scots pine plants, either 2-years' seedlings, or 1-year–1-year transplants, were then planted in the tracks, in what we might describe as fairly thick order, for the total number of plants was 8000 per acre. The young plants took well to the dug soil, when protected by the heather from frost, and, being fairly thick in the lines, a quick branch-suppression was effected on two sides, and canopy was fairly quickly established by the meeting of the branches between the rows. It was stated that the digging of the trenches cost £1, 13s. 4d. per acre. The ground was netted, as rabbits were plentiful. On leaving this Scots pine plantation we came to a better class of soil, which had been stocked very much after the fashion of our own mixed woods. The method of management, however, was different. After the plantation had been established for six years, a certain number of species were cut down to the ground, and a certain number left uncut. Those left uncut were oak, ash, elm, larch, and hornbeam, and those cut down were white alder, willow, birch, and sycamore. The cutting down had been done four years prior to our visit, and we certainly saw what our sportsmen would call a very fine game covert. By this treatment the crop was improved, and the struggle intensified just at the proper time. In the future, many of the species cut down will develop into straight, well-grown trees, and those left uncut will be drawn up and sheltered just at the period when the struggle for mastery and shelter are important factors; but, of course, it has to be remembered that the all-important thing is the subsequent management. A striking feature observed in connection with these woods was the way in which the crop had been adapted to the various kinds of soil. The poorer land is on the southern slope, and here the crop is pure Scots pine. On the opposite slope, in descending which the land becomes richer, the crop consists of mixed hardwoods.

The sylvicultural features of the coniferous woods here require special mention. At one place (see Fig. 2) we saw the trees standing at from 18 inches to 24 inches apart. This plantation was somewhere between ten and fifteen years of age. The dead branches had all been pruned off, with the double object of improving the prospective value of the timber and to facilitate the shooting of the roe-deer, which are the greatest enemies the

Belgian forester has to contend with. As regards pruning on its own merits, it was stated that, so far as dead branches were concerned, Scots pine could be pruned with impunity, but that spruce must on no account be pruned. It should be noted, however, that here the prunings could be readily sold. Another special feature of these pine-woods is the method of clearing off the crop, and again replanting about two years afterwards. When mining-timber is the object in view, it has been found that it is most profitable to make clear-fellings at forty years of age. The method adopted in clearing here is to pull every individual tree out by the root by means of the apparatus shown in Fig. 3. The roots can all be sold for fuel, and after the ground is cleared it is ploughed and cropped for one or two years, and manured with basic slag. The ground is then netted in, and planted with 2-years' seedlings, or 1-year–1-year transplants, at the rate of 8000 per acre. The planting is done by means of a planting-iron, the operation resembling somewhat our own "notch" method, and by this means a man and a boy can plant 4000 plants per day. It was found, however, on pulling up a few of the plants, which had been planted two years previously, that the rootlets were often twisted, though it must be admitted that the roots of forty-year-old trees, pulled out by the apparatus already referred to, had wonderfully straight roots. It cannot be too often reiterated, however, that twisting of the tiny rootlets in nurseries, and careless notch-planting, give rise to a large death-rate amongst young pine-woods. In consequence of careless planting, the plants often die off after they have reached the age of six or eight years. The replanting here is all done under the shelter of older woods, a method we should do well to imitate. We could not, however, imitate the other details just referred to, as in this part of Belgium everything can be disposed of, and labour and plants are cheap.

Regarding the management of young pine-woods, our little guide-book gives the following particulars:—

"The following statement gives the results of thinning an acre of pine-wood, thirty-eight years old, in 1892, showing the consequent improvement in volume-increment. Thinnings of pines have been too often neglected in Belgium.

"The increment for the thinned wood in five years has been:—2507 – 1900 + 250 cubic feet = 857 cubic feet; for the unthinned wood: — 2394 – 1940 cubic feet = 454 cubic feet;

and, per annum, 171 cubic feet and 91 cubic feet respec tively.

"The volume of the average tree, in 1902, was:—

$$\text{Thinned wood} \quad -\frac{2507}{1940} = 1{\cdot}3 \text{ cubic feet.}$$

$$\text{Unthinned wood} - \frac{2394}{2540} = \cdot 9 \text{ cubic feet.}$$

"Thus, while the volume per acre is almost doubled by the thinning, the volume of the average tree in the unthinned wood is only $\frac{9}{13}$ths of that of the average tree in the thinned wood."

Now, what are the lessons to be learned from the above? The increase in volume of the *thinned* as compared with the *unthinned* wood is very striking, and some may be disposed to use this as an argument in favour of our own thinly stocked woods. But here they plant 8000 plants to the acre, while we sometimes plant as few as 2000, and we get therefore not stems, but scrub and branches. The great lesson for us, however, is not to copy the methods adopted here, but rather to follow the principles in so far as they are compatible with common-sense and good management.

It is dangerous and often impracticable to lay down hard and fast rules, but, in a general way, it may be said that no pure pine-woods should be planted at a greater distance apart than 3 feet (4840 plants per acre); that thinning should be deferred until height-growth has culminated; and that the final number of stems per acre should be in proportion to the size of the individual trees which the land will carry.

On Friday, 18th August, we drove from Brussels to the forest of Soignes, which, in a general way, may be said to be a fine pure beech forest, thickly grown, and in many parts consisting of trees containing 100 cubic feet of timber on the average, and 70 feet to the first branch (see Fig. 4).

Here we were shown some interesting experiments in the thinning of beech-woods at thirty-eight years of age, and the effect of soil-protection on the crop.

Various experiments had been made, but the underlying principle in all of them was the great advantage of creating a struggle for supremacy during the first thirty-eight years of growth, and then relieving the stronger trees. In the struggle the individual trees may be said to have reached three zones of

height—viz., the dominant, dominated, and suppressed. The best results were obtained by taking out a certain number of the dominated trees, thus encouraging the dominant ones, and using the suppressed to protect the soil.

At Groenendael the first and chief part of our programme came to an end; and while all the aspects of Belgian sylviculture have by no means been enumerated here, it may be truly said that, from an educational point of view, the tour was perhaps the most important one which the Society has yet undertaken.

For the photographs illustrative of this paper, I am indebted to Messrs A. C. Forbes and Fraser Story.

XIX. *The Town-Woods of Carlsbad (Bohemia).*

By the HON. EDITOR.

Somehow or another, the notion seems to be widespread in Britain that the application of a methodical working-plan to the management of woodlands practically means destroying their wild, natural beauty and producing nothing but crops of gaunt, bare stems like telegraph-poles. But nothing can well be wider of the mark than any such random rush to a conclusion. The primary object of any and of every working-plan should be to submit practical proposals, by the acceptance and carrying out of which the intentions of the proprietor (whatever these may be) shall be given effect to—as *thoroughly*, as *quickly;* and as *economically* as possible. It therefore naturally follows that the prescriptions of different working-plans may vary as widely as the intentions of the individual landowners, and that when the desire of the owner is mainly in the direction of ornamental effect, an *Arboricultural Working-Plan*, based on sound scientific foundations, must necessarily be something quite different from a purely *Sylvicultural Working-Plan*, having for its avowed chief object the production of timber-crops on strict business principles.

The best example known to me of an Arboricultural Working-Plan for extensive woodlands is that which was introduced some years ago for the management of the town-woods of Carlsbad, the seat of the celebrated mineral springs in Bohemia. And the success which has attended the carrying out of the prescriptions of this scheme for management on æsthetic principles seems to me to make it desirable to introduce this subject to the closer attention of landowners, land-agents, and foresters in Britain.

The beneficent results obtainable by drinking and bathing in the warm mineral waters of Carlsbad have been known for at least 700 years, as is proved by ancient legal deeds; and the springs are so celebrated as now, despite the powerful competition of many rival establishments, to have attracted, during each of the last two years, about 55,000 "cure-guests" to undergo the course of treatment for two to four weeks, besides more than twice that number of casual tourists. One of the great attractions of Carlsbad for the "cure-guest" has always been, from time

immemorial, the beautiful woods which extend to the S.W., S., and S.E. of the town, flanking the hills on both sides of the tiny Tepl, flowing northwards and joining the river Eger at the lower extremity of the town.

Among German poets, Goethe, Schiller, and Körner have sung the beauties of this well-wooded valley, and at different times during the nineteenth century the amenities of the woodlands have been enhanced by opening out pleasant walks and clearing well-situated points of view. But of recent years far more has been done to increase the charms of the Carlsbad woods, both by opening out carriage-drives and foot-paths, and by subjecting the forestal management to almost purely æsthetic considerations, thus placing ornamental effect in the first place, and making income per acre entirely a subordinate side-issue. In taking definite action in this respect some years ago, the municipality were unanimous, and they resolved to be thorough. And there can be no doubt that the step they took was well considered in the best interests of the town, because the townspeople of Carlsbad (numbering about 15,000) subsist almost entirely on the cure-guests, and the combined amount of income deliberately forfeited by non-sylvicultural treatment of the woods, and of expenditure on ornamental effect and up-keep, is very amply repaid in the greater attractions offered to cure-guests and tourists. Further, this was even a matter of self-defence, because the municipality and the citizens of Carlsbad are wise enough to know that unless the attractions of their quaint old town and its charming woodlands are made progressive, there is always a danger of the tide of fashion ebbing, and a flow setting in towards other places offering, on the whole, very similar attractions.

When the systematic working-plan was first drawn up, about ten years ago, its details were very soon found to be too elaborate for successful application, and a modified scheme was adopted, which has now been in application for several years with excellent results, and to which the following remarks apply.

The total woodland area amounts to about 3145 acres (or about 5 square miles), divided into the three main blocks, *Stadtgut* (1975 acres) to the west of the town and of the Tepl valley, *Soos* (720 acres) to the east of the town, between the Tepl and the river Eger, and *Ploben* (450 acres), forming the

southern continuation of these two blocks. The lowest point, in Soos on the river Eger, is 1170 feet above sea-level, while the highest, the Veitsberg, in Ploben, is 2130 feet, the local differences of hill and dale thus ranging up to 955 feet. The mean annual temperature is 45°·7 Fahr., but this gives little real information, as the winter cold is severe and the summer heat great, while the climate is rather damp than dry, except during the summer months. So intense, indeed, is the hard frost in winter, that only the Colorado species of Douglas fir thrives here, the cold being too severe for the Pacific species. These hills are chiefly composed of granitic rocks of coarser or finer grain, with small intrusive patches of eruptive basalt here and there. The soil produced by the decomposition of the coarse-grained granites yields in fairly level situations a deep, humose, and somewhat heavy sand, favourable to the growth of mixed crops of spruce, silver fir, and beech, while the finer-grained rocks furnish a rather poorer soil, on which Scots pine usually forms part of the crop. Despite its elevation, its extremes of winter cold and summer warmth, and its somewhat free exposure to the winds from the north and west, the situation is, however, favourable to the growth of mixed woodlands of most kinds of European hardwoods, softwoods, and conifers, as well as of exotic trees introduced for their ornamental effect. A suitable place can be found for everything, as the configuration of the land varies from almost level spots in the sole of the valleys, to sheltered coombs, or gentle slopes, and to steep hill-sides often abruptly diversified with rocky precipices, while the aspects of the different hill-sides vary as much in number as the points of the compass. There is, consequently, abundant opportunity for the forester to introduce picturesque groups of trees in the positions most suitable to their growth, and where their form and foliage appear most likely to be seen to the best advantage.

These town-woods are under the management of a head forester assisted by six foresters, who have comfortable and picturesque houses situated near the centre of their respective charges, and whose duties consist not only in carrying out the ordinary woodland operations, but also in supervising the opening out and maintenance of the carriage-drives and foot-paths intersecting the woodlands in every direction. In these 5 square miles of forest, there are no less than 12½ miles of good driving-roads and 56 miles of well-laid-out foot-paths, for

the upkeep of which there is a special annual allotment of about £1660. These foot-paths are so arranged as to provide suitable and agreeable promenades for all classes of cure-guests, who can thus have ample choice between almost level tracks, or gently sloping ascents, or steep braes that make the stout and unwieldy go panting and "larding the lean earth" in putting in the daily amount of exercise prescribed by their physician. And, of course, wherever there is an abrupt precipice, or any knoll from which a fine view is obtainable, paths lead in various directions up to it, and benches or a look-out tower command the panorama. All over the woods comfortable benches provide resting-places at convenient distances, while finger-posts indicate the points towards which the paths lead. And at main crossing-points there are large, well-built shelters, offering good protection from rain. In each of such shelters hangs a large map of the woods, showing all the net-work of roads, paths, etc., and indicating plainly the point at which the wayfarer now finds himself. There is thus no fear of anyone losing himself; but to make sure assurance doubly sure, the woods are, from about 10 A.M. onwards, well patrolled by guards in uniform, who are in attendance in the early morning at the mineral springs before entering on their other daily routine in the woods. These 56 miles of foot-paths afford such an immense variety of woodland scenery, that even the cure-guest staying for the full term of four weeks need have no feeling that he is following a familiar or monotonous path. He can vary his walks day by day, ever enjoying new beauties of nature assisted by art, while deriving pleasure and instruction from the manifold and ever-varying scenes that disclose fresh beauties and interest at every turn of a path. Long lonely walks along such paths can never be tedious to those able to hold silent commune with the trees around, and every group seems to have its own story to tell to those who seek for and take note of it.

These woods are just as interesting to the forester as to the simple lover of woodland beauty on its own account. Here a big patch of old Scots pine, thin in the crown and carpeted with heather below, among which sturdy beech-saplings have recently been set about 8 or 10 feet apart, tells how, from one cause or another, the crop has been allowed to get so thin that the soil has deteriorated; and now the kindly aid of the beech, "the mother of the woods," has been invoked to nurse it back

into better condition. Close by, on the steep slope of a hill, there is a thick mixture of beech and spruce in close canopy, with clean healthy stems and well-developed crowns of foliage, from which the dead leaves of former years lie thickly strewn on the well-protected and humose soil. Farther on, following a path fringed, but not too thickly or regularly, by mountain-ash and maples, there is a vantage-point from which an extensive view is to be had looking northwards over the fertile plain of the Eger towards the distant range of the Giant Mountains, the boundary between Bohemia and Bavaria, between Austria and Germany. And beyond that again, there are masses of mixed silver fir and spruce, and Scots pine and larch, all treated more or less on the "group system" of natural or artificial regeneration, and enlivened by the silvery gleam of the smooth bark of birch trees. Where there is a limy out-crop here and there, there will often be found a mixture of Austrian pine, larch, Weymouth pine, maple, and sycamore, etc.; while the lower and more fertile tracts along the valley of the Tepl abound in fine stretches of mixed beech and oak, along with ash, elm, and other hardwoods and softwoods; and, of course, poplars, willows, alders, and birch prevail on the moister portions more particularly suited for them.

As the main object of management is æsthetic, in order that the woods may best serve as a part of the cure to supplement, or complement, the action of the mineral waters, while sylvicultural considerations are merely of secondary importance (and, indeed, can hardly even be considered of much importance at all, as the small net income derived is reserved for buying land for planting, and thus rounding off the boundaries of the town-woods), the whole woodland area has been divided into two zones, to each of which a somewhat different method is applied. The first of these, extending to about 670 acres, or a little over 1 square mile, consists of those portions of Stadtgut and Soos immediately adjacent to the town, and comprising several rocky eminences from which fine views are obtainable ("The Stag's Leap," "Franz-Joseph's Hill," "Three-Cross Hill," "King Otto's Hill," "Life Everlasting," "Findlater's Temple," etc.). These consist for the greater part of broad-leaved woods, interspersed with groups of conifers.

The woods in this zone are treated entirely by the system

of sporadic or casual (so-called "selection") fellings, only over-mature or unhealthy trees being removed here and there, as occasion requires, and the gradual regeneration being provided for either naturally by self-sown seed or else artificially by planting. As many of the hill-sides in this zone have very steep slopes, stout hurdles have to be inserted so as to run in broken horizontal lines set at close distances apart. It is only thus that the dead foliage, and the friable, earthy layer of the surface-soil can be retained in position, so steep are many of these hill-sides; and such mechanical support is also just as much needed to support plants set there out of the nursery as to provide a suitable germinating-bed for self-sown seed. All cultural operations within this first zone are therefore unusually costly, owing to the steepness of the hill-sides; and the perseverance and success with which such natural difficulties are there overcome form of themselves a striking object-lesson in arboriculture. The care and attention of the forester is constantly required; natural regeneration is sparse and altogether insufficient; and even artificial regeneration, in the form of underplanting, has to be carried out at great expense, with stout 8- to 12-year-old plants, twice transplanted in the 7½ acre nursery maintained for this purpose. In the more heavily overshadowed places, only beech and hornbeam are set—or beech alone, if necessary; where the shade is less, ash, maple, sycamore, elm, and lime are planted, and oak only where it can have a fair amount of light. All of such plants usually wilt for some years after being planted, in consequence of their removal from the free, open nursery to the shade of the old woods; but when once they are able to accommodate themselves to this great change of environment, they do well in the good humose soil. Recent sowings of beech chiefly, and also of maple, sycamore, and durmast oak, have done well, and give promise of this cheaper method being introduced as extensively as may be found practicable.

In order to carry out æsthetic principles as thoroughly as possible within this zone, young, well-branched trees of vigorous growth are left standing when regenerative falls are being made; while, of course, the falls are conducted only to such an extent as may ensure the foot-paths and resting-places being kept always cool and shady, and may prevent the surface-soil from being washed away during rainfall—a very important and difficult matter on the steeper hill-sides specially exposed to the danger

of earth-slips. This part of the woods, close to the town and within easiest reach by foot, offers the greatest variety of broad-leaved trees, the paler green of whose foliage contrasts well with the darker green of the numerous interspersed patches of firs and pines; but, for the forester, some of the most interesting parts are perhaps a few stretches of 150-year-old spruce and Scots pine in picturesque groups, throughout which are scattered small patches of 20-year-old spruce intermixed with beech, oak, maples, birch, and mountain-ash. Towards the south of this zone, near "Lord Findlater's Temple," there is also a very interesting wood of beech, about 150 to 200 years old, intermixed with Scots pine, spruce, and silver fir, growing on a steep slope with southern exposure. Here only moribund trees are felled, or diseased stems which might possibly be dangerous to pedestrians during high wind. In fact, throughout the whole of this first or inner zone, only trees that are over-mature, diseased, or physically weak are removed in favour of those left standing and of the younger growth which will gradually replace the existing stock.

The second zone, comprising the remaining 2475 acres of the town-woods, extends beyond the inner zone to a total breadth of from 2 to 2½ miles from E. to W., and a length of from about 1 to 2 miles from N. to S. up the valley of the Tepl. In this section, which also contains numerous vantage-points and outlook towers ("Russel's Seat," "The Virgin's Image," "Belvedere," "Abild," etc.), the woods chiefly consist of coniferous trees, interspersed here and there with stretches of beech on the hill-sides, and broken up by small meadows where the water-courses run through level parts. On the plateaux there are good mixed woods of spruce, silver fir, and Scots pine, while on the hill-sides there is also an intermixture of beech, forming up to about one-fifth of the crop. The finest growth is to be found in the block Ploben, that forming the extreme southern portion of the town-woods, where there are old crops of pure silver fir, spruce, and Scots pine, the latter of which have been underplanted with the two former kinds in order to protect the soil from deterioration. Planting is usually done at distances of 4½ to 6 feet apart, with stout transplants. Here too, however, much has been done to create pleasing mixtures of these evergreen conifers and of beech, the latter sometimes forming well over one-third of the whole crop, while poor agricultural land bought within the

last forty years has been mostly planted with a mixture of oak, maple, sycamore, and beech. Many of the young woods date from about 1868 to 1875, when considerable damage was done here by storms, snow-break, and injurious insects throughout the older crops.

The woods in this second and more distant zone are treated somewhat more sylviculturally than those in the first zone, so as to form larger and more homogeneous, but yet ever-varying and always typical, groups of woodland scenery, instead of aiming mainly at the production of fine and picturesque individual trees and small groups of trees. But here, too, pleasing effects and æsthetic considerations are the first and chief object of management, while the amount of net income desirable is entirely a minor consideration; and the compartments into which this area is subdivided vary from about 50 to 110 acres each, which is considerably larger than the compartments in the first zone.

The portion of the working-plan now in force for this second zone is based on a rotation of 100 years, which of course, however, permits of fine old trees being retained long in excess of that age adopted as the general average. The distribution of the age-classes was found in 1900 to be approximately as follows:—

	Acreage of Age-Classes.					
	Acres and Years.					Total Acres.
	1-20	21-40	41-60	61-80	81-100	
Normal Distribution,	495	495	495	495	495	2475
Actual Distribution,	480	650	300	445	600	2475
Variation from the Normal, . . . +	...	155	...	...	105	+ 260
Variation from the Normal, . . . −	15	...	195	50	...	− 260

This age-class table is reconstructed every 10 years, after stock has been taken of the growing crops, and its main use is to enable a clear view to be taken as to the progress of their regeneration. But meanwhile the annual fall made each year is based on the average annual increment on all the existing crops, and this is at present estimated at about 50 cubic feet actual contents (or nearly 40 cubic feet by square-of-quarter-girth measurement) per acre. Inclusive of thinnings, the mean

average yield during the last 25 years has been about 168,000 cubic feet actual contents (or about 130,000 cubic feet square-of-quarter-girth measure) per annum, which corresponds very closely with the above estimate; while during the last 10 years the gross annual income has averaged about £2700, and the expenditure £2250. This leaves only about 2s. 10½d. per acre as the net annual return from the capital invested in the timber-crops and the soil, which is, of course, only a small fraction of what could easily be obtained from a purely sylvicultural management on business principles. But everything is done to render the woods as pleasant as possible to visitors during the spring, summer, and autumn seasons, hence even all kinds of work in the woods is accomplished, so far as possible, between October and April, when labour is scarce and dear, and the days are short.

There is little or no total clearance even of old, over-mature crops growing on soil that has become deteriorated, as even in such case very gradual clearance round the edges is preferred, with planting to supplement or take the place of natural regeneration. And the same is done with the younger conifer crops of backward growth, such as those about 50 years of age and only 30 to 40 feet in height, as experience has shown that even free thinning does not enable the trees to recover energy of growth and beauty of form. Sporadic felling in small patches is the rule; and unless there are self-sown family groups that can grow up satisfactorily in the freer exposure to light and air, the blanks thus formed are filled by planting. And the result of this sort of treatment is to produce mixtures of many kinds of woodland trees, sometimes occurring pure in patches of varying area, or else forming mixtures in which different kinds of trees are interspersed either merely as scattered individuals, or else in groups of varying size and age.

Such open woods are always more exposed to damage from wind than crops standing in closer canopy, consequently windfall or damaged trees are numerous, and these must be speedily cleared to avoid the danger of forming breeding-centres for noxious insects. Another result of the wider distance than usual from stem to stem is the fact, of particular interest to the British forester, that the soil is often thickly overgrown with a dense tangle of rank weeds. In many places there is, even under the heavy shade of spruce, a thick undergrowth (consisting here

chiefly of elder, mountain-ash, bracken, whortleberry, etc.), showing that if the canopy be opened out much, the soil becomes densely overrun with weeds, just as is precisely the case in our British woodlands.

Despite hard winter frost and damage from wind and snow-pressure already referred to, these woods are not unduly exposed to dangers of any sort. Where there are so many thousands of pedestrians, most of them smokers, there must always be a certain slight risk of fires occurring. But the only case in which a serious conflagration seemed impending occurred on 28th June 1818, and it was fortunately extinguished by a heavy rainfall during a thunderstorm.

Fungous diseases are not liable to spread under a system which only removes over-mature and unhealthy trees, but *Æcidium elatinum* is not uncommon on silver fir, and *Nectria cinnabarina* is frequent on maple and sycamore. I saw no canker on any of the larch; but there was a bad attack of the larch mining-moth, which made the young flushing buds look as if they had been badly nipped by frost, in the middle of May (1905).

Among injurious insects, the "Nun" or spruce moth did a good deal of damage in some of the spruce and pine woods thirteen or fourteen years ago, when the devastations were being caused by it in Bavaria during 1890-92. Even now sample-plots are ringed with patent viscous tar once every two or three years to see if any of the caterpillars of this dreaded pest are present in the woods. But the best means of protection are the song-birds, with whose welcome notes the woodlands resound in spring, and for whose protection and increase thousands of wooden nesting-boxes have been fixed high up in the trees. The Pine Geometer-moth was also at the same time (May 1905) doing damage to a slight extent.

The chief causes of damage of the above kind during the last ten years have been *Pissodes piceæ* and *P. harcyniæ*, and in a minor degree *P. pini* and *P. piniphilus* (which are two of our British species); and trees attacked by the two first-named are so specially liable to also become attacked by the common Agaric fungus, that it seemed for some time doubtful whether the insects or the fungus were the primary cause of the diseased condition. The observations of the last three years indicate, however, that the insects are the primary cause of impaired vitality, and the fungous attack the secondary consequence of this; because the

rootlets of the trees can resist the entrance of the rhizomorphous filaments, except when their vitality and functional powers are weakened after insect attacks.

Although exterminative measures have now been employed continuously for several years against these destructive weevils, they are only gradually being got rid of. Careful inspections are constantly being made all the year round, and stems found attacked are felled and barked to prevent the issue of the perfect insects. In addition to this, decoy stems and branch-sections are left on the ground to act as traps for egg-laying, and are then barked to destroy the eggs.

In conclusion, it may be remarked that the whole of the domestic water-supply of the town of Carlsbad is derived from these town-woods, whence it is conducted in pipes.

XX. *Notes on Continental Forestry in* 1905.

By the HON. EDITOR.

FRANCE.

In France the budget allotments for forests and inland waters during 1905 provided, as is now usual, a large sum for the improvement and conservation of waste lands in mountain tracts. Of total receipts amounting to £1,184,204 from the State Forests, £554,280, or close on one-half, are allotted to their maintenance, improvement, and extension, and of this outlay no less than £131,000, or nearly one-quarter, are for the above specific purpose. The payment of officials of gazetted rank requires £100,200, while £112,800 go to the subordinates, for the pension-fund in favour of whom there is also a special contribution of £8000, beside £29,360 paid as indemnities and extra pay. For technical instruction in forestry the allotment is £38,000, of which £29,000 is for professorships, etc., and £9000 for other expenditure. Besides the £131,000 specially allotted to waste lands in mountainous tracts, £50,800 were to be devoted to the improvement and maintenance of the forests and of dunes and inland water-courses, £16,800 to working-plans and utilisation of forest produce, £84,000 to upkeep of roads, £10,240 to sundries, such as office expenses, first uniform for subordinates (£1128), and acquisition of rights of pasturage, etc., £2000 for maintenance of sport, and £1040 as "awards for the destruction of wolves, wild boars, and crows," —from which it would seem apparent that the wild rabbit is not so destructive a pest as with us, or as it is also now becoming in some parts of Germany.

Among the French colonies, in Algiers the State Forests do not yet yield any surplus, but, as the income is £117,145 and the expenditure £121,567, the deficit is only £4422. The establishment employed accounts for £76,659, general work in the forests for £23,820, harvesting the cork-oak bark £16,800, sundries for £2828, and planting of waste lands for £1200. In Tunis, too, the budget for 1905 also shows the very slight deficit of £200, the receipts being £24,424 and the outlay £24,625. But the allotment of £1440 to the fixation of dunes makes all the difference between a surplus and a deficit, the other expenditure being £5764 on establishment, £3724 on material, £9240 on demarcation and

improvement of the State Forests, £3160 for their maintenance, and £1440 contributed to the fund for the Forest service. Indo-China, however, more than makes up for Northern Africa, by showing a surplus of £19,460, the receipts being £47,760 and the expenditure £28,300, of which £23,633 are connected with establishment, £3166 for material and buildings, £815 for sundries, and £686 for works of improvement in the woods.

I have given these French financial statistics in detail, in the hope that by some chance it can perhaps be impressed on the attention of Government that forests do contribute very directly towards the useful and profitable employment of several classes of the population in a well-wooded country. There are 664 officials of gazetted rank and 3650 subordinates; but I am unfortunately unable, from the statistics at my disposal, to give the amount and value of the manual labour required, while, of course, it is impossible to form even a remote estimate of the further sums brought into circulation by transport, conversion of raw material, etc. But the above figures are at any rate suggestive, and they are all the more so when it is recollected that, in 1905, the State Forests of France formed less than one-eighth of the total wooded area, which is classifiable as follows:—

	Hectares (=2·47 acres).
(*a*) State Forests, ...	1,169,820
(*b*) Woodlands owned by communes or private corporations—	
Under State management, ...	1,938,760
Not under State management, . . .	297,852
(*c*) Private woodlands, ...	6,217,090
Total, .	9,623,522

In order to make available all land considered suitable for agriculture, the sale of parts of forests in the plains was sanctioned by laws passed between 1852 and 1868, and many tracts were thus disposed of before such work was completed in 1870 (about 77,000 acres having been sold for £1,200,000 between 1860 and 1870), since which date the acquisition of waste land for planting has been the only cause of change in the area of State-owned Forest. And how large a field is still open for activity in this direction may be seen from the following estimate of waste land:—

	Hectares.
Heath, moorland, and barren sandy wastes (*Landes*),	3,898,530
Uncultivated, rocky, and mountainous tracts,	1,972,994
Marshy lands,	316,373
Turf-bogs,	38,292
	6,226,189
	(= 15,378,686 acres).

Under the terms of a law of 1882, the inquiry made regarding the mountain tracts which should be acquired and planted by the State—an inquiry now approaching completion at an early date—shows that about 345,140 *hectares* (=852,495 acres) are thus classifiable, namely:—

	Hectares.
In 66 Alpine districts,	211,948
In 40 Cevennes and central mountain-range districts,	95,342
In 18 Pyrenean districts,	37,850
124 districts,	345,140

And of this area the State has already acquired 395,715 acres, or not far from one-half, for planting. For each locality a definite plan of operations is submitted, sanctioned, and worked up to; and year by year a report is drawn up for each district, giving details of—(1) expenditure on acquisition; (2) the history and the results of work done; (3) details of work; and (4) expenditure on work. For twenty-one years these operations have been steadily pursued, the lowest expenditure having been £47,152 in 1875, and the highest £160,152 in 1890, while for the last ten years it has averaged well over £120,000.

In the *Revue des Eaux et Forêts*, the early numbers for 1905 contain two interesting papers on the past history and the present condition of the woodlands. Mr Tessier's article traces their history downwards from the early Celtic time, when there was no proprietorship in woods, through the Roman period, when the trees and other products were still nobody's property, and the land was divided into *fundi*, each *fundus* being the holding of one *eques*, with all his vassals and slaves. During the Middle Ages, from the ninth to the eleventh centuries, the last traces of Gallo-Roman proprietorship of small holdings dis-

appeared, and large estates became formed, the local lords or *seigneurs* gradually acquiring the virtual possession of all the lands originally held by those then subject to his orders or under his protection, but thenceforth only held on feudal tenure. Even as early as 1355 there were many complaints made that the forests were being cleared, while in 1543—the same date as Henry VIII.'s great *Statute of Woods*—an edict for the first time *declared that the preservation of private woodlands was a matter of public utility, and submitted them not only to the jurisdiction, but also to the supervision, of the Masters of Woods and Waters;* and this principle remained in force down to the Revolution, in 1789.

During the sixteenth century fears were entertained (as also in England) about the maintenance of future supplies of timber, and orders were given for allowing one-third of the royal coppices to grow up into highwoods. But during the seventeenth century vast clearances were made, and many woodlands were turned into wastes. Despite Colbert's ordinance of 1669 prescribing a definite method of treatment, the clearance often went so far as to interfere greatly with the natural water-storage and the regulation of torrents, as was particularly noticeable in the case of the Rhone, the largest of all the Alpine rivers.

During the Revolution a wholesale clearance of the forests went on, in much the same way as seems now to be happening in Russia, and it is said that the law of 1791, which organised a new administration for the State Forests, but left each proprietor free to do what he liked with his woodlands, led to the destruction of about 957,000 acres of the private woodlands within twelve years. Between 1798 and 1803, drafts of the *Code forestier* were introduced and amended, the ordinance of 1669 being partially re-enforced, the communal woods being submitted to the same management as the State Forests, the clearance of private woodlands being regulated, and a commencement being made with the planting of the barren sand-dunes of Gascony.

But although Dugied had, in 1819, written convincingly about the destruction of pastures by the torrents sweeping down from denuded areas,—although, in 1824, the forest administration had been again reorganised and a forest school instituted at Nancy, and the *Code forestier* had been finally voted in 1827,—and although Surell had, in 1841, published his celebrated work on Alpine torrents, nothing was done until 1860 to cope with the

great national work, then at length seen to be necessary, of planting waste lands in mountainous tracts. On the contrary, between 1814 and 1847 over 700,000 acres of State Forests were sold for sums amounting to £9,520,000. Before this, however, a terrible inundation of the Rhone had caused sixty-three *conseils généraux* to insist upon the necessity of doing something to replant the clearances made in the mountain tracts, but it was only in 1860 that the Bills successively introduced finally became law, and £400,000 a year were granted for ten years to begin work experimentally. The close connection between woods and water-supply has since then impressed itself more and more deeply, year by year, on the mind of the French people, and in the Eleventh Congress of the Society of Navigation of the Loire, held at Nantes in October 1904, it was acclaimed that "all those occupied in river navigation now admit as truth the saying—'*if you want water, create woods.*'" In the Pyrennean districts the mountaineers have shown a good deal of stubborn resistance to improvements by planting, but this is now yielding under the influence of the *Association pour l'Aménagement des Montagnes*, and many communes have already voluntarily taken steps to commence work.

The plan adopted in 1860 was as follows:—In each district where such works were decreed to be necessary, the private land-owners could retain their land by carrying out the prescribed works at their own expense, assisted by State contributions; but otherwise the land was expropriated, although the old proprietor had the right to resume possession within five years, either by refunding the actual cost of the work (capital plus interest) or by giving up one-half of the area; while, as regarded land belonging to communes and corporations, the State could occupy it without expropriation, carry out the necessary work, and retain possession of it until all the advances were completely repaid; the commune had, however, the right to exercise pasturage on the planted areas as soon as the plantations were old enough to permit of this, and could claim entire exemption from any payment on giving up one-half of the land, and preserving its right to the other half. This raised a great outcry about oppression of the pastural industry, and it was urged that turfing would be quicker and cheaper than planting, and equally effective; but after a new law to this effect was brought into force in 1864, a return had to be made to planting in 1870. After fourteen years

of study and experiments, a definite plan was adopted and published in 1878 (Demontzey's *Practical Treatise, etc.*).

The law now in force is that of 1882. This provides State-aid for non-obligatory works of utility; but, for those of sufficient importance to be declared obligatory, the land is expropriated and the necessary works are carried out by the State, unless (which rarely happens) a special arrangement is made between the State and the landowners for these to execute them, in which latter case expropriation is only made in the event of the works being badly done or not kept in proper repair. And where such works are in process, the exercise of pasturage on all the communal lands has to be regulated, although this cannot yet be said to be done effectively. This law of 1882 can, however, be worked without creating the unavoidable friction formerly caused by that of 1860, and the result of this has been that the benefits of planting are annually gaining widespread recognition with regard to the security and improvement of pasturage, the regulation of the water-supply, and the prevention of devastating floods and avalanches.

The State Forests are, of course, managed upon scientific and business principles, which are also applied to the communal and corporation forests submitted to State management, although allowances have often to be made as to requests for permission to make extra falls to cover deficiencies in the communal budgets, or to authorise extra pasture for the grazing of cattle. Many municipalities have been able to increase greatly the produce from their forests by following intelligently the prescriptions of their working-plan, while others can only see objectionable restrictions in the measures recommended, and try to evade them. The communal forests not subject to State control are, for the most part, small in area, and are generally in a very neglected condition.

Most of the private forests are fairly well looked after, and many of them are managed on the sound principle that not more than the annual increment should be cut each year. But it is seldom that the owners derive the full benefit which the land might be made to yield, because many of the woods have been hitherto managed for the production of fuel, whereas the economic changes of the last fifty years have caused a more rapid increase in the price of timber than of firewood and charcoal. Thus, in Paris alone, despite the increase in population, the quantity of

firewood and of charcoal consumed has sunk by nearly one-half during the last twenty-five years, while the quantity of coal, anthracite, and coke has increased by one-half. The conversion of private woodlands into highwoods for timber is being constantly urged by the State (see *Transactions* for 1905, p. 164), but this has to face the practical difficulties that only a comparatively small number of large proprietors can command the services of highly-trained foresters, and that conversion must always mean loss of present revenue for the sake of improved returns later on. But, as "union is strength," some of the smaller proprietors are now beginning to form themselves into local associations in order to combine and obtain the services of well-trained wood-managers and subordinates, and generally such benefits as have been already achieved for agriculture by the formation of *syndicats agricoles*. And this movement is being encouraged not only for the sake of the benefits that will accrue to the landowners themselves, but also for the other national-economic advantages thereby obtainable. It is not only, however, as regards sylviculture that the advantages of skilled management and good supervision are evident, because protective works are also better carried out. This is clearly shown in the case of the hill-forests of the Estérel (on the Riviera), aggregating 35,000 acres, about one-half of which are State-owned and the other half communal, where fires have, during the last fifteen years (1890 to 1904), overrun seven times as large an area in the communal woods as in the State Forests—in which protective works are better carried out, and there is a better network of roads and paths upon which to base operations.

Among the more purely sylvicultural articles, there is a very interesting one on the "Treatment of Scots Pine in the Region of Paris." Introduced there from farther north, it has shown such a tendency to reduced longevity and precocious seed-production as to necessitate a different method of treatment from that obtaining in localities where this tree is indigenous. Thus, for example, in place of a rotation of 100 to 120 years or more, the working-plan of 1892 for Scots pine (15,000 acres) at Fontainebleau fixed it at 72 years (1893-1964), divided into eight periods of nine years each, but even this was found (on a revision in 1902) to be much too high, and a decree of 22nd April 1904 has further lowered it to 56 years (1893-1948), divided into eight periods of seven years each, because

it has been found that the monetary return is not only larger, but the seed-production is also much more favourable for natural regeneration, at from 50 to 60 years than at any higher rotation, owing to a very large proportion of the trees becoming dead in the crown and moribund from the attacks of canker-fungus. Throughout this region natural regeneration, it may be remarked, is obtained by leaving from forty to sixty seed-bearers per acre, while the soil is prepared by clearing away heather, bracken, etc., and working it up in strips or patches; and seed is sown in places where it has not been possible to reserve seed-bearing trees, while blanks are subsequently beaten up by planting.

Although the mixed forests of France are less subject to insect-attacks than the pure woods of coniferous trees common throughout many parts of Germany, yet serious damage also occurs every now and then.

On 1st February 1902, in the Vosges mountains, a hurricane in a few hours threw 43,175,000 cubic feet of coniferous timber-crops, of various ages, valued at £360,000. As is always to be feared under such circumstances, this has been followed by a sudden increase in noxious insects, among which the chief were *Bostrichus typographus* attacking spruce, and, to a minor extent, *B. curvidens* attacking silver fir. The former is to be found in British woodlands, but extensive damage has not hitherto been caused by it after cyclonic storms, probably owing to the comparatively slight extent to which spruce is grown. But, if large plantations should ever be grown for pulp-wood, this is a danger that must always be kept in view, because one female can lay 80 eggs, which may easily multiply into 3200 in the second generation, 128,000 in the third, and 5,120,000 beetles in the fourth, and this all in the space of two years if these happen to be dry and warm, although during cold and damp years the generation is usually only annual. In the present case there appears to have been two broods in 1903, and in that autumn the presence of an unusual number of the insects was noted, although it was not realised how serious was the danger they threatened. The position was only thoroughly apprehended in May 1904, when orders were immediately issued for taking active exterminative measures throughout the tracts infested, the trees were carefully examined, and those found to be attacked were felled, lopped, and barked, and the bark burned in large fires made with the branch-wood. It was not easy to distinguish the

trees attacked, as the eggs are seldom laid within 7 feet of the ground; and the insect is rarely found in the branches. There is seldom any external sign of the infestation until the bark is destroyed by the lateral galleries formed by the caterpillars, when the tree sickens and dies rapidly, and then it must be felled and barked at once to prevent the exit of the beetles. At first old trees are preferred, but in cases of large infestation trees of all ages are attacked. By felling 14,603 trees found to be attacked (measuring 640,000 cubic feet, and valued at £14,000), the danger has been partially overcome; and estimating 150,000 to each tree, this means the destruction of over 2000 millions of insects. There still remained the fear that a new infestation might occur in 1905, but climatic checks and natural enemies appear to have fortunately obviated this danger.

Of other noxious insects, the oak-tortrix (*T. viridana*) has for the last three years, and in some localities for four and five years in succession, attacked pure oak-woods and mixed oak and beech in the Paris region, extending from the Vosges to Brittany and throughout the central plateau, or about one-half of the total area of France. Both in 1903 and 1904 the production of acorns was destroyed, and the rate of growth was seriously reduced, more especially on large and valuable trees, and Professor Henry estimates the loss at several millions of cubic feet in each year.

Curiously enough, it also happened that the storm of 1st February 1902 damaged four sample-plots on which experiments had been commenced in 1892 to study the effect of thinning in silver fir-woods eighty-three years old, resulting from natural regeneration freed from the overhead shade of the parent standards in 1840 to 1850, and thereafter thinned only to the extent of removing dead and suppressed trees. This interfered with the experiment just when it was becoming most interesting, but, all the same, useful results were noted on the fallen trees being worked up. Four sample-plots, of about 1¼ acres each, having been selected in two lots (1 and 2, 3 and 4), similar as to soil and situation, one of each was thinned and the other left as it was, the standing trees being numbered and their diameter and height registered. In 1899 a second thinning was made in plots 1 and 3, and an analysis of three of the wind-fall stems showed that although the growth in height had apparently not been much affected, the rate of growth in girth had been greatly increased at about 5½ feet over the

ground, but had decreased by about 10 per cent. at the top end of the bole, while the increase in rate of growth in volume had been marked from about three to four years after the thinning, and was still rapidly increasing when the trees were thrown. Such an effect as to growth in girth had previously been noted by Professor Huffel, of Nancy, in 1893, and this experiment confirms his previous observations. The mean annual results of the measurements were as follows:—

	Mean Annual Rate of Growth in		
	Diameter		Volume.
	At 5½ feet up.	At top of bole (45 feet).	
	Inches.	Inches.	Cubic feet.
Before thinning, . . .	0·712	1·060	0·315
After thinning, . . .	1·160	0·972	0·525
Difference, . .	+0·448	−0·088	+0·210

But the result of the thinning, as evidenced over the whole sample plot, was more remarkable than that on the mere individual tree, the total increment in volume being greater in the thinned than in the unthinned part; the total increase in girth near the base being as large in the thinned as in the unthinned part, and the mean annual increase in girth per stem at 5½ feet being just twice as large in the thinned part as in the unthinned portion. And the advantage thus gained is, of course, all the greater in the former case, because the trees left standing are the best of the crop, the weaklings being eliminated by the thinning; and this concentration of increment on a smaller number of superior trees is one of the great benefits obtainable by thinning. The total mean annual increase per acre during the ten years was estimated to be as follows:—

Area.	Growing Stock (1892).	Average Annual Increment (1892-1902).
	Cubic feet.	Cubic feet.
Thinned, ...	5460	171·64
Unthinned, . . .	7224	162·68

The effect on the money-value of the growing stock was at the same time equally marked, being estimated at $3\frac{3}{4}$ per cent. on the capital value of the growing-stock in the thinned part, as compared with $2\frac{3}{4}$ per cent. on that in the unthinned. This is just one of the useful kinds of experiment which it seems desirable to carry out at many centres throughout the United Kingdom, in order to provide object-lessons for those desirous of studying such questions.

GERMANY.

As usual, both the *Allgemeine Forst- und Jagd-Zeitung* and the *Zeitschrift für Forst- und Jagdwesen* contain a vast amount of interesting information concerning scientific, technical, statistical, and other matters connected with the working and management of the German forests, with, of course, the never-failing dash of strong controversial feeling manifesting itself here and there.

The Forestry Budget of Prussia for 1905-06 is just as interesting as that of France, although it also does not enable one to form any correct idea of the real extent to which the woodlands directly and indirectly contribute to the permanent employment of rural labour. The State Forests, now aggregating 7,127,000 acres, yield a gross income of £4,987,550, and, deducting expenditure amounting to £2,489,205, a net revenue of £2,498,345 (which is £59,205 less than in 1904-5), or over 7s. per acre as interest on the capital value of land and timber-crops. But, as many of the expenses are not strictly for maintenance and upkeep, etc., the actual amount which might be considered the net return is in reality considerably above this. Thus, for forest schools and scientific investigations £23,320 are provided, and £200,000 as an *extraordinary* contribution for the acquisition and planting of waste lands, in addition to the ordinary annual allowance of £52,500 for waste-land improvement. (During 1904, 9750 acres of waste land were planted by the State, and 9100 acres were acquired for planting, and there were still 68,780 acres of State-owned waste land in hand for this special purpose.) In fact, the total for *extraordinary* expenditure amounts to £294,350, and includes £32,500 for building houses for foresters not yet thus provided for, £10,000 for redeeming servitudes, £7500 for fitting up telephones in the forests, and £9350 for three new schools for forest apprentices (see also below). The forest service, or gazetted

and subordinate permanent establishments, cost £854,000 (including all salaries, allowances, contributions to pension-fund, etc.); felling, extraction, and regeneration cost £1,114,164; and sundries amount to £212,415. There are 889 head foresters and higher officials, 120 forest accountants, 3925 foresters, and 715 assistant foresters, but the number of labourers entertained permanently in the woods is not given.

So, too, in the State Forests of Bavaria (2,313,000 acres), the budget for 1905 showed a gross income of £2,082,500, and an expenditure of £914,200, leaving a net revenue of £1,168,300, or over 10s. 1d. per acre. The permanent establishment (consisting of 743 officers and 1698 subordinates) cost £318,000, £7765 was allowed for forestry instruction (at Munich University, at Aschaffenburg, and at five elementary schools for forest apprentices), and £475,150 was spent on work in the forests (of which £337,400 was for the felling and handling of wood, and £72,500 for soil-preparation, sowing, and planting, *i.e.*, about £400,000 was distributed among hands employed on daily labour).

Hitherto, in Prussia, there have been two elementary schools, at Proskaw and Gross-Schönebeck, to educate apprentices for the subordinate forest service; but these have now been found insufficient. As about two hundred apprentices are needed annually, and as it has been decided that it is not convenient to have more than fifty in one school, four schools have been organised from 1st October 1905—at Gross-Schönebeck, Margoninsdorf (Posen), Steinbusch (Frankfort-on-Oder), and also Hachenburg (Wiesbaden), that at Proskaw being given up. Attendance at one of these schools for a twelvemonth's course is now obligatory, and must take place in continuation of a twelvemonth's practical course spent under a head forester in the woods. The apprentices live collegiately inside the school buildings, a charge of £3, 12s. for the year being made for lodging and tuition, while the messing is provided at 1s. a day by a steward. For this they get early milk, breakfast, mid-day meal, afternoon milk, and supper, the daily ration amounting to 1½ lb. rye-bread, 1½ pints milk, 2 oz. butter, and 6 oz. meat; but there is always extra bread on cut in the hall between meals, and on Sundays and general holidays a "ha'penny cookie" is added to the fare. On such simple diet the young and growing lads should always have a fine, healthy appetite; and between their gymnastics,

their simple diet, and the fine fresh woodland air, they ought to lay in a good stock of health. In addition to practical instruction and outdoor work in forestry, sport, fruit-culture, fish-rearing, and bee-keeping, they receive systematic indoor instruction in the usual branches of forestry, in woodland sport, in matters concerning the forest laws and regulations that will afterwards concern them, and in German, arithmetic, composition, drawing, and the elements of natural history and science,—besides which they have physical exercise in the form of gymnastics and swimming, are made to practise shooting, and are taught singing and horn-blowing, as in Germany the *battues* still often begin with a horn-signal. The school-year is from 1st October till 15th September, but during the planting-season the apprentices have to work for five or six weeks as planting-hands under proper supervision, and at Christmas and Easter they have a further release of fourteen days from lectures, being then employed on outwork works of protection, etc. In each of the four schools the supervision is vested in specially selected forest officials, the school itself being under the control of a director.

For British foresters, one of the most important lessons that can be learned from Germany in 1905 is that relating to the successful manner in which bisulphide of carbon (CS_2) can be used to reduce swarms of rabbits; and this is of sufficient importance to be worthy of a short article to itself (see pp. 104-106).

Bisulphide of carbon was also, towards the end of May 1905, successfully tried for the extermination of cockchafer-grubs infesting a young oak-plantation at Lampertheim, in Hesse. The operation, which seems rather an expensive one, is described as follows:—

"The damage began in the second half of May. First an isolating trench was dug, 10 inches deep, and holes were bored from 4 to 10 inches deep with an iron rod, at distances varying from 10 to 40 inches apart. At least $\frac{1}{8}$ oz. (fluid) of the carbon bisulphide is measured out in a graduated glass and poured into each hole, which is then closed at once. The holes should be made to go rather horizontally below the surface, as otherwise the grubs near the top may not be affected. Soil-moisture is essential for success. In the above case no grubs were to be found fourteen days after the treatment, and the plantation recovered. Where the holes were wider apart than above, or where less than $\frac{1}{8}$ oz. of the bisulphide was used, the damage

and regenerated on reaching maturity at sixty to eighty years of age. In the State Forests such protective strips are to be annually inspected before 15th March by a party of forest and railway officials, who must report on their condition and on what is necessary for their proper maintenance. Such works as felling and thinning are then to be done at the cost of the Forest Department; but the expenditure on the lopping of branches to a height of 5 feet, the removal of the soil-covering, and the hoeing of strips, is recoverable from the Railway Department.

The effect of different degrees of thinning is, of course, receiving much attention throughout Germany, and the new experiments are now being standardised according to the classification adopted by the Forestry Investigation Committee, namely:—

I. *Dominating trees*, forming part of the leaf-canopy, and consisting of trees with—

1. Well-shaped stems and a normally developed crown.
2. Badly-shaped stems or poorly developed crowns, including those which—
   (*a*) Suffer from side-pressure;
   (*b*) Are rough and branching (advance-growth in natural regenerations);
   (*c*) Are otherwise badly grown (forked, etc.);
   (*d*) Scour and whip the branches of their neighbours;
   (*e*) Are diseased and unhealthy trees.

II. *Dominated trees*, no longer forming part of the leaf-canopy. These include—

3. Trees not yet overshadowed (unsuppressed).
4. Suppressed trees that are overshadowed, but are still quite capable of vegetation.
5. Moribund and dead trees.

Of the above classes, 3 and 4 can often be of use for soil-protection, or may help to clean the boles of other trees, but class 5 is of no use whatever to the rest of the growing-stock—in fact, such trees are a positive danger (insects, fungi). With the growth of experimental areas in Britain, some general standard is desirable; and it would perhaps be best to accept that determined on for Continental Forestry Investigations.

It will, of course, be many years before the results of experiments made under this new classification can become available,

but some of those made under older systems (which are really much the same in the main *for practical purposes*, though not so finical and would-be highly scientific—perhaps, however, it is heresy to express such an opinion); but some interesting details concerning the latter were given at a Forest Conference held in Constance, in which the comparative results of (a) *slight*, (b) *moderate*, and (c) *heavy* thinnings were given in the ratio of the results of the moderate thinning (100). They may be tabulated as follows:—

Timber-Crop.	Age.	Period of Observation.	Percentage of Total Increment in Cubic Contents in the Thinnings that were		
			(a) *Slight.*	(b) *Moderate.*	(c) *Heavy.*
	Years.	Years.			
Scots pine, .	37	17	96	100	111
Beech, . .	56	21	88	100	113
Beech, . .	56	21	99	100	108
Silver fir, .	49	15	93	100	101
Oak, . . .	38	Not stated	...	100	110

In considering these figures, it should, however, be borne in mind that what the German forester calls a heavy thinning is something quite different from the wholesale slaughter of the innocents that so often takes place in our British plantations under this name. And the same caution must be intoned before summarising an article by Professor Schwappach on the thinning of young spruce-woods. Commencing with the statement that in Germany the general principle acted on is to form spruce-woods so that they may close up as quickly as possible, to begin to thin at about thirty to forty years of age, and to make the thinnings heavier as the woods grow older—an opinion he has hitherto shared and has advocated in his published works, and which has received support from the experiments made by the Investigation Committees in Prussia, Bavaria, and Wurtemberg—his attention was recently drawn to the somewhat different results of similar experiments made by the Austrian Committee at Mariabrunn, and in Prince Schwarzenberg's woods in Bohemia. He therefore obtained official permission to make a "tour of study" in 1904, visited the centres in question, and drew his own conclusions, which he has now published. Without attempting to

condense his twenty pages of measurements and remarks thereon, his conclusions (affecting spruce-woods only, of course) are that—

1. Growth in very close cover produces badly developed crowns, and reduces their power of assimilation.
2. The present system of growing spruce closely at first, and then thinning freely only during middle age, does not utilise the productivity of the land fully, and therefore causes loss to the proprietor.
3. The badly-developed crowns can only rehabilitate themselves slowly, and on poor soil often not at all; hence late thinning does not exercise any very beneficial effect on the total increment.

National treatment of spruce-woods should therefore consist in—

4. Not forming the young crops too thick—say, where planting is adopted, using from 1600 to 2400 plants per acre [*i.e.*, about 4½ feet apart (in squares), which would give an average growing-space of about 20¼ square feet].
5. The number of poles to be gradually decreased by frequently repeated cleanings, and by thinnings as soon as the lower branches begin to die off to a height of about 15 or 16 feet.
6. The aim of thinning should be to produce the largest possible number of stems of good growth, with well developed and regular crowns, and distributed as equally as possible over the whole area.
7. The live, actively vegetating part of the crown should, on the average, never come down below 30 per cent. of the height of the tree.

In a subsequent article on the economic effect of heavy thinning, Schwappach considers the question of such treatment of pine, spruce, beech, and oak in respect to total increment, both as regards volume and value, and arrives at the following conclusions:—

1. *The total increment in volume* is certainly not diminished by heavy thinning, but is more or less enhanced, except in the case of Scots pine, where, however, it cannot as yet be shown to have occasioned any decrease.

2. *The total increment in value* is always enhanced by well-conducted, careful tending, even when the yield from thinnings is not reckoned at compound interest up to the time of final clearance.
3. The final yield of the mature woods is, of course, usually smaller in woods that have been freely thinned, but the difference in money-value is not so great as the difference in volume might indicate, because the value per cubic foot is higher on the average; hence the smaller quantity may easily represent the large value, as was especially shown (in the investigations) to be the case with spruce and oak.
4. The most favourable effect on the increment in value obtainable in young and middle-aged woods is not to be achieved by the old system of thinning out only suppressed and moribund stems, but by slightly interrupting the canopy (*Hochdurchforstung*, a method now borrowed from France, where it has long been in practice, and is known as *éclaircie par le haut*), somewhat in the manner of a very slight partial clearance to stimulate increment.

Schwappach's observations about the thinning of young spruce-woods are not, however, allowed to go unchallenged, for Professor Martin (also of the Neustadt-Eberswalde Academy), in the course of a very sensible criticism, points out that *there can be no general rule as regards planting-distance at first and distance from stem to stem later on*, but that local circumstances must always be an important factor in determining what may be the most advantageous method of thinning. And that is, of course, merely stating a common-sense opinion, for a landowner wanting to grow pit-wood will adopt quite a different method from the proprietor desirous of providing material for a saw-mill engaged principally in turning out boards and planks, etc.

Following on the five violent gales which in 1904 threw down large quantities of timber in the Prussian forests (over 1,250,000 cubic feet being thrown on the Harz on 17th June 1904), a wide-spread storm on the night of 6th January 1905, coming from N.W. and N.E. (in different localities), threw over 3,200,000 cubic feet in the State Forests alone.

With regard to the fixation of atmospheric nitrogen by the humus-layer in woodlands (see *Transactions* for 1904, p. 168),

Professor Hornberger of Münden has published the results of his experiments, which tend to show that Professor Henry of Nancy was completely wrong in the conclusions he arrived at; but the latter points out that the Münden results could not be other than they were, owing to their having been carried out under defective conditions, which naturally led to conclusions previously obtained by Kostytcheff under similar conditions.

From an article on experiments in spraying young Scots pine in nurseries from the middle of June till the end of August, it appears that the Burgundy spray (a solution of Heufeld's copper-soda in cold water) is easier to prepare and cheaper than, and equally as effective as, spraying with the Bordeaux mixture (a solution of copper, vitriol, and lime), and its use is strongly recommended in young plantations to keep down the heavy outlay sometimes occasioned in beating up blanks caused by the attacks of the leaf-shedding disease (*Lophodermium Pinastri*).

Two of the German forest academies celebrated their seventy-fifth anniversary in 1905—Eisenach (in Saxe-Weimar) having been founded in June 1830, and Neustadt-Eberswalde (near Berlin) in August 1830. Eisenach has been under three directors only,—König, Grebe, and Stoetzer,—and though the question of transferring the course of instruction from Eisenach to Jena University has more than once been suggested, it is considered best to retain the academy in its convenient proximity to large and instructive woodlands. Neustadt-Eberswalde, on the other hand, was founded as an off-shoot from Berlin University, to provide better technical instruction near the woodlands than could be arranged for in the capital. The great outstanding figure in connection with it is Danckelmann, who was director for nearly thirty-five years (1866 to 1901). It will be a long time before any such anniversary celebrations will be held in Britain.

XXI. *The Twenty-eighth Annual Excursion - Argyll, Ayr, and Renfrew, 5th to 8th July* 1905.[1] By the ASSISTANT EDITOR.

Under exceptionally fine weather conditions the Twenty-eighth Annual Excursion of the Society was held in the counties of Argyll, Ayr, and Renfrew, the principal estates visited being Benmore, Cessnock, Lanfine, Loudoun, Erskine, and Pollok.

On the forenoon of Wednesday, 5th July, the General Meeting of the Society was held in the show-yard of the Highland and Agricultural Society at Scotstoun, under the presidency of Mr Steuart Fothringham, and thereafter the Excursion party spent the afternoon in making a tour of the Glasgow City Parks, under the guidance of Mr Whitton, the superintendent, who had made excellent arrangements for their visit, and had carefully mapped out an interesting programme for them.

The party, which was under the leadership of Mr Buchanan, *Convener* of the Excursion Committee, consisted of the following gentlemen:—Robert Allan, Polkemmet, Whitburn; John Annand, Haystoun, Peebles; Thomas Blair, Hoprig, Gladsmuir; John Boyd, Pollok, Pollokshaws; John Broom, Bathgate; W. R. Brown, Heckfield, Winchfield, Hants; T. R. Bruce, Old Garroch, Dalry, Galloway; C. Chisholm, Hattonlaw, Lundin Links; Wm. Christie, Fochabers; James Cook, Arniston; R. W. Cowper, Gortanore, Sittingbourne; J. H. Cumming, Grantully, Aberfeldy; W. R. Elgar, Hillside, Sittingbourne; James Farquharson, Inverkip; James Forbes, Overtoun, Dumbarton; Robert Forbes, Kennet, Alloa; James Forgan, Sunnybraes, Largo; Robert Galloway, *Secretary*, 19 Castle Street, Edinburgh; John Gellatly, Newhall, Penicuik; A. T. Gillanders, Park Cottage, Alnwick; James Gossip, Inverness; Peter Gow, Laggan, Ballantrae; John Hay, Kilmarnock; Wm. P. Hay, Loanhead; Peter Henderson, Ballindalloch; Wm. Henderson, Clonad, Tullamore, King's County; Sir Archibald Buchan Hepburn, Bart., Smeaton-Hepburn, Prestonkirk; Richard Hogg, Glenapp, Ballantrae; Thomas Hood, Bogend,

[1] Notes for this Report have been kindly furnished by Messrs Whitton, Stewart, MacBean, and Boyd.

Duns; Frank Hull, Lilleshall, Newport, Salop; David Inglis, Kirkcaldy; James Johnstone, Alloway Cottage, Ayr; James Kay, Bute; John Kerr, Barney Mains, Haddington; D. P. Laird, Pinkhill, Murrayfield; George Leven, St Quivox, Ayr; S. MacBean, Erskine, Bishopton; John M'Callum, St Ann's Cottage, Lockerbie; James M'Donald, Powerscourt, Co. Wicklow; John M'Kerchar, Upper Holloway, London; W. H. Mackenzie, Dean Road, Kilmarnock; W. H. Massie, Edinburgh; John Methven, Blythswood; James Middleton, Braehead House, Kilmarnock; Alex. Milne, Edinburgh; R. W. Milne, Hillside, Lockerbie; J. H. Milne-Home, Broomlands, Kelso; Alex. Morgan, Turret Bank, Crieff; Hugh Morgan, Crieff; A. J. Munro, Edinburgh; Alex. Murray, Murthly; A. D. Page, Culzean, Maybole; Colonel J. Porteous, Turfhills, Kinross; W. M. Price, Minto, Hawick; A. D. Richardson, *Assistant Editor*, Portobello; A. B. Robertson, Dean Road, Kilmarnock; H. Rutherfurd, Fairnington, Roxburgh; David T. Samson, Grantown, Strathspey; Frank Scott, Blackmoor, West Liss, Hants; Thos. Sharpe, Monreith, Wigtownshire; James Shiel, Abbey St Bathans, Grant's House; James Shields, Longniddry; John Smith, Peebles; Adam Spiers, Edinburgh; Wm. Steven, Dalkeith; Duncan D. Stewart, Castlehill, Inchture; Wm. Stewart, Dalhousie; Jas. Stoddart, Bonnyrigg; Fraser Story, University College, Bangor; Robert Taylor, Broomhall, Charlestown; Jas. Wm. Watt, Carlisle; E. Whittinghame, St Mary's, Newport, Salop; Jas. Whitton, Glasgow; J. Williamson, Loanhead; Wm. Wilson, Auchinleck; Edward Wiseman, Elgin.

Victoria Park, Partick, was the first on the programme, and the chief item of interest here was the fossil grove, the stems of the trees forming which have been preserved *in situ*. The inspection of the park over, the party drove by Balshagray Avenue and Great Western Road to the Botanic Gardens. In passing through Balshagray Avenue, some grand old elm and beech were seen, but, alas! these are rapidly dying, and their end is being appreciably hastened by the construction of a sewer in the middle of the roadway. In the Botanic Gardens, too, the conditions are now much less favourable to tree-growth than formerly, and it was noted that here also the old beech were on the wane. From the Botanic Gardens, in which is a fine range of plant-houses, including the well-known Kibble

Conservatory, and a lily pond and students' garden, the party drove by Garrioch Bridge and Bilsland Drive to Ruchill Park, where some planting of an experimental kind is being carried out. Owing to the pollution of the atmosphere by gases from foundries, glass-works, etc., in the vicinity, only the hardiest of trees and shrubs will grow here, those which have been found to thrive best being species of *Crataegus* and *Pyrus*, *Cotoneaster frigida*, and *Rosa rugosa*, which, curiously enough, seem to do better here than in some other apparently more favoured situations in the city. The party next proceeded to Springburn Park, which has the highest altitude of all the city parks, and here again it was noted that thorn and *Pyrus* were the trees which seemed to thrive best in the smoke-polluted city atmosphere. After an inspection of the fine Winter Garden the party resumed their drive, and passing through the north-eastern part of the city, where a number of the large locomotive engineering works, Parkhead Forge and St Rollox and other chemical works are situated, Tollcross Park was reached. Here attention was drawn to what might be described as three distinct generations of trees, the oldest of which are fast dying off owing to the effects produced by the underground workings. After a light refreshment, kindly provided by the Corporation, the party drove southwards, passing through Glasgow Green, where the difficulties attendant upon tree culture in cities are all too evident, to Queen's Park. Here the atmospheric conditions are much more favourable, and the trees are, for a city, comparatively healthy; but in the old Caledonian Camp which covers the hill it was noted that the grove of beech was now showing marked disagreement with its environment. An inspection of the Propagating Department, from which all the plants for decoration at municipal functions, etc., are supplied, finished this part of the tour, and a move was next made to the old garden and grounds of Camphill, where the last Cedar of Lebanon in the city grows; but the condition of this tree affords ample proof that evergreen conifers are ill-adapted to the smoky conditions which obtain in large cities. A drive through the residential district of Pollokshields by Maxwell Park to Bellahouston Park brought the tour to a close, and to those unacquainted with the city of Glasgow and its atmospheric conditions the afternoon's outing was, especially from an arboricultural point of view, an extremely

interesting and instructive one, and the party expressed themselves as highly pleased with all they had seen, and with the good work which Mr Whitton is doing in Glasgow; and they also felt deeply grateful to him for the great amount of trouble he had taken in preparing and carrying through such an interesting programme.

On Thursday, 6th July, the party visited Benmore, the fine property of Mr H. J. Younger. The route from Glasgow, which was left at 8.30 A.M., was by Gourock and Dunoon, and from the latter place the party was conveyed in brakes, by Loch Loskin and Glenmasson, to Benmore. On arrival at Benmore, the party was met by Mr Younger, Colonel Younger, Mr Cameron, factor on the estate, and other officials. After a short time spent in the well-stocked and well-kept nursery, the party repaired to the arboretum and policies, where specimens of coniferous and broad-leaved trees were found in great profusion, and in fine health. The newer Coniferæ are not much more than thirty years old here, yet some of them have attained to considerable dimensions, a plant of *Abies grandis* about 70 feet high and 7 feet in girth at breast-height being noted. Of those which were noted as being specially promising may be mentioned *Tsuga Mertensiana* (*Albertiana*), *Abies Nordmanniana*, *A. nobilis*, *A. grandis*, *Thuya gigantea*, and *Sequoia gigantea*. Many fine specimens of broad-leaved ornamental trees and rare shrubs were also observed, and the neat way in which everything was labelled was much appreciated.

After the tour of the arboretum and policies was completed, the party made their way to the Cruach Douglas fir plantation, of which the following particulars have been kindly supplied by Mr J. M. Stewart, forester, Benmore:—

This plantation was formed in the latter part of 1878 and beginning of 1879. It extends to about 100 acres, of which about 35 acres consist of pure Douglas fir, about 20 acres of a mixture of Douglas fir and *Thuya gigantea*, with a sprinkling of Scots pine and common silver fir, while the remaining portion consists of a mixture of Douglas fir, larch, Scots pine, spruce, etc. The plantation is situated on the face of a steep, undulating, rocky hill, facing east by north, and varying in altitude from 54 feet to 777 feet above sea-level. Over the greater part of the hill the soil consists of a sandy peat. This soil rests on clay, slate, and quartz, and has a depth of from 4 to

6 inches, which is now being increased by the deposition of humus.

The part of the plantation which consists of pure Douglas fir has not as yet been thinned, and the crop has an average height of from 47 to 50 feet. The plants were put in at 3 feet apart, and in some parts almost every plant has survived, and is growing vigorously; and although in other parts there are many weaklings, the plants are almost in every case still alive. Over the whole area the trees now stand about 6 feet apart on the average. The branches are now dead to a height of from 25 to 30 feet, but they still adhere to the stems. The girth of the trees is very irregular, varying from 18 inches to 57 inches at 6 feet from the ground. If this plantation were now thinned, I should say the average girth for the crop left on the ground would be about 44 inches.

The Douglas fir in that part of the plantation where they are mixed with *Thuya gigantea*, Scots pine, and silver fir, have not attained to the same height as those in the pure Douglas fir part, but they exceed them in girth. The height of the Douglas fir in this part is about 38 to 40 feet, and their average girth is about 45 inches. The Scots pine, and the greater part of the silver fir, have been completely suppressed, but the *Thuya gigantea* have held their own, and compare very favourably with the Douglas fir in height and girth, as well as in symmetry of bole. As it stands at present, this part of the crop consists of about three-fourths Douglas fir to one-fourth *Thuya*, with an occasional silver fir. In most cases the silver fir fall short of the others in height, but, as a rule, they have the advantage in girth. I may say, however, that it is only in exceptionally thin parts, or near the edges of the rides, where silvers are to be found. In this section the trees are thinner on the ground than in the pure Douglas fir part, owing to all the Scots pine having died, and the distance apart at which they now stand varies from 5 to 8 feet.

In the remainder of the plantation, where they are mixed with larch, etc., the Douglas fir have outgrown all the others in height, but their stems are much rougher, owing, apparently, to their having made room for themselves and retained their side branches for a longer period than either those grown pure or in mixture with *Thuya gigantea*. In no case, however, do any of the other kinds overtop the Douglas fir.

The Excursionists were kindly entertained to luncheon by Mr and Mrs Younger, and Mr Younger, who presided, welcomed the party to Benmore, and hoped they would repeat their visit. The healths of Mr Younger and his factor, Mr Cameron, were proposed by Sir Archibald Buchan Hepburn and Mr Buchanan respectively, and three cheers were given for Mr Younger's household. The beautiful gardens and other parts of the grounds were afterwards inspected, and a most enjoyable outing, to which the attention bestowed on the party by Mr Cameron, and by Messrs Stewart and Greenlaw, the forester and gardener respectively at Benmore, contributed in no small measure, was thus brought to a close. The party returned from Blairmore Pier, and travelling *via* Gourock reached Glasgow at 8.40.

On Friday, 7th July, the programme included the West of Scotland Agricultural Experimental Station and Dairy School at Kilmarnock, and the estates of Cessnock, Lanfine, and Loudon. Starting from St Enoch's Station at 8 A.M., Kilmarnock was reached about 9, and thence the party was driven in conveyances to the Experimental Station at Holmes Farm. Mr Johnstone, on behalf of the Governors of the College, welcomed the party, and thereafter they were conducted over the various parts of the experimental ground by Principal Wright, Professor M'Alpine, Mr Drummond, and Mr Tudhope, the superintendent. Principal Wright and Professor M'Alpine described the experimental work which is being carried on, and the latter furnished many interesting and important details regarding the experiments. The Dairy School and the beginning of what is to form a demonstration plot for forestry teaching were the last items on the programme, on the conclusion of which three hearty cheers were given for Principal Wright and his staff, and a start was made for Cessnock.

This part of Ayrshire is not extensively wooded, and the plantations for the most part consist of shelter-belts. By far the best timber seen was at Crosslands, where there is a fine Scots pine-wood about 90 years old. The trees are of clean growth, and the volume of the timber on the ground is estimated at somewhere about 2500 cubic feet per acre. Of course a great deal of timber has already been removed from the plantation, but as to the amount of this no information was obtained. On arrival at Cessnock Tower, luncheon was served

in a large marquee. Mr Turner, Commissioner to the Duke of Portland, presided, and on behalf of his Grace, who was unable to be present, welcomed the party to this part of Ayrshire. Luncheon over, the healths of the Duke and Mr Turner were proposed by Sir Archibald Buchan Hepburn, who, on behalf of the company, asked Mr Turner to convey to his Grace the thanks of the Excursionists for his kind hospitality. Thereafter a visit was paid to the old Tower, in order to see a fine ceiling which, after being hidden by lath and plaster for a long period of years, had recently been exposed to view. It belongs to the seventeenth century, and the joists and under side of the flooring, which are quite exposed, are covered with quaint paintings, apparently in some kind of water-colour. The painting is in an excellent state of preservation, and means have been taken to support the joists by steel girders placed above them, and from which they are suspended. The drive was now resumed, and Lanfine was soon reached.

At Lanfine arboriculture, rather than sylviculture, is the prevailing feature. The grounds are well stocked with trees and shrubs of all sorts, amongst which many of the newer Coniferæ bulk largely. There are also many fine deciduous trees, and the rhododendrons, which are in large numbers and in big masses, must be exceptionally fine when in flower. Mr Mackinnon, the proprietor of Lanfine, accompanied the party over the grounds, and before taking their departure they were kindly entertained by him to refreshments on the lawn. Three cheers were given for Mr Mackinnon, and the journey was resumed. At Loudon a halt was made in order to see the Castle, with its famous old yew-tree, under which the Treaty of Union was signed, the Earl of Loudon being one of the signatories. The stem of this venerable tree girths 14¼ feet at 3½ feet from the ground, and the spread of its branches extends to 75 feet. On the way to Kilmarnock flying visits were paid to Ladyton and Templetonburn. At the latter place, the residence of Mr R. Johnston Paton, a fine new rosary was seen, and also some nice bits of "wall" gardening. The Excursionists were hospitably entertained to tea by Mr Paton, and leaving Kilmarnock at 8 o'clock, Glasgow was reached about 9.

On Saturday, 8th July, the last day of the Excursion,

the estates of Erskine and Pollok, in Renfrewshire, were visited.

Leaving Glasgow at 8.30 A.M., the party drove by way of Renfrew to Erskine, a detour being made through the Blythswood policies. Erskine is the property of Mr W. A. Baird, who succeeded to the whole of the Blantyre properties on the death of his grandfather, the late Lord Blantyre, about five years ago. The Excursionists were met by Mr MacBean the land-steward and forester on the estate, and under his guidance they were conducted through the Shilton Woods, where some large oak and Scots pine had recently been felled. These trees were about 130 years old, and the quality of the timber was very fine. The vigorous health of the younger plantations also impressed the party very much, the injurious effects of the Glasgow smoke, owing to the direction of the prevailing winds being south-westerly, not affecting them much. At Erskine House the party was met by Mr Baird. After a walk through the Park, where there are some fine large trees, the party was entertained to luncheon by Mr Baird in the mansion-house, and thereafter, under his guidance, an inspection of some of its principal apartments was made. The house contains a magnificent collection of historical furniture and works of art of almost priceless value. Of greatest interest, perhaps, were a cabinet which belonged to Mary Queen of Scots, and a large mirror and casket presented by Charles II. to Frances Stuart of Richmond and Lennox. Afterwards a fine old wood near the house, consisting chiefly of oak, larch, and sycamore, all the more open parts of which are being planted with some of the more valuable Coniferæ, was visited; and a "mixed" plantation of about 7 acres, formed in March 1904, after a crop of heavy hardwoods, and which is showing remarkably good progress, was much admired. Time would not permit of any of the other plantations being visited, nor could a visit be paid to the Golf Course, which by many experts is considered to be the finest in the west of Scotland.

On behalf of the party Mr Buchanan thanked Mr Baird for his kind hospitality, and congratulated him on the success of his efforts to improve the condition of forestry on his estates; and after giving three hearty parting cheers, the party drove *via* Paisley to Pollok.

The following are the girths of some of the large trees in the Park:—

		Ft.	Ins.
Sycamore	(1903) . .	15	7
Walnut	(„) . .	7	8½
Oak	(„) . .	11	8½
Spanish Chestnut	(„) . .	15	2
Beech	(„) . .	16	0
Cedar of Lebanon	(„) . .	10	1½
Do. do.	(„) . .	9	11
Scots Pine	(„) . .	9	4
Do.	(„) . .	9	4¼
Sycamore	(1898) . .	19	4
Do.	(„) . .	15	6¼
Oak	(„) . .	18	11

On arrival at Pollok the party was met by Mr J. Campbell Murray, factor on the estate, and Mr J. Boyd, the forester. The nursery at Cowglen was first inspected. This was found to be well stocked with broad-leaved trees of various kinds, and with seedling conifers for the proprietor's Highland estate of Corrour, Inverness-shire. From the South Lodge the party drove through the fine park stretching along both sides of the river Cart. The old trees are in a dying state, but it was noted that clumps of young ones had been planted to take their place. A visit was also paid to the creosoting-tank. This is constructed on what is known as the "open" plan, *i.e.*, the tank consists of an open boiler in which the timber and creosote are placed, and the temperature of the latter raised to a little over 212° Fahrenheit, at which it is kept for forty-eight hours or thereby. Many samples of creosoted timber, both broad-leaved (oak, ash, elm, beech, sycamore) and coniferous, were shown to illustrate the effectiveness of the process, and Mr Boyd had cross-sections of larch and Scots pine prepared to show how the creosote did not penetrate the heart-wood, but that the sap-wood was completely impregnated with it. The boiler, which is egg-ended, is 25 feet long by 5 feet in diameter, and can therefore take in a large quantity of material at a time. The party then proceeded to Pollok House, where they were entertained to luncheon by Sir John Stirling-Maxwell. Mr Murray, who presided, on behalf of Sir John, welcomed

the party to Pollok, and expressed Sir John's regret that he was unable to be present. Mr Murray referred to the great difficulty they experienced in getting trees to grow at Pollok owing to the impure atmosphere. Mr Buchanan gave the health of Sir John Stirling-Maxwell and Mr Murray, and asked Mr Murray to convey to Sir John the thanks of the party for his kindness in allowing them to visit his property, and for his splendid hospitality; and thereafter, under the guidance of Mr Heron, the gardener, a visit was paid to the flower-garden, on which extensive alterations have recently been made, and grounds. A very remarkable beech tree was seen in the grounds. This tree has really no stem, the branches arising from the ground level, and giving the tree the aspect of a gigantic "witches' broom." The saw-mill, the most up-to-date yet seen by the Society, was next visited. The party then walked back past Pollok House and rejoined their conveyances; and a drive through the North Wood by way of the fine avenue, which from the house to the gate is fully a mile long, brought them to Haggs Castle, where a halt was made for a few minutes, and thence it was continued to Glasgow. Passing through the North Park a fine artificial pond was noted, and here the party had an excellent opportunity of seeing the deleterious effects produced on the growth of trees by a polluted atmosphere such as that which obtains in this district, the effect being especially marked on the Scots pine. On reaching Glasgow the members of the party took their various ways homeward, and so the Twenty-eighth Annual Excursion of the Society, favoured all through by the best of weather, came to an end.

XXII. *Forestry Exhibition at the Highland and Agricultural Society's Show at Glasgow, July* 1905. By the ASSISTANT EDITOR.

Although the Forestry Exhibition which the Society held at Glasgow was not on such an extensive scale as that held at Perth in 1904, it was nevertheless one of a very interesting and instructive kind. The Highland and Agricultural Society again voted the sum of £20 to be awarded in prizes for timber, but on this occasion the competition was open to the United Kingdom, instead of being, as in the previous competitions, confined to Scotland. This brought two competitors from Ireland, and two of the awards went across the Channel. In Competition No. 1, for three boards each of Scots pine, larch, and spruce, the first prize was carried off by the Marquis of Breadalbane, who showed a very fine lot of boards, the Scots pine especially being of extremely fine quality. The second prize went to Mr Steuart Fothringham of Murthly, whose Scots pine boards were also very fine; while Viscount Powerscourt took third place. In Competition No. 2, for boards of any three coniferous timbers other than those specified in Competition No, 1, the first prize was carried off by Lord Powerscourt, with boards of Douglas fir (*Pseudotsuga Douglasii*), *Thuya gigantea*, and Californian redwood (*Sequoia sempervirens*). These boards were of very fast, but clean, growth, and it was observed that those of *Thuya gigantea* especially had shrunk very considerably in drying. The second prize went to Captain Stirling of Keir for boards of *Abies Nordmanniana*, *Cedrus Deodara*, and *Araucaria imbricata*, but they were of much coarser growth than Lord Powerscourt's specimens. In Competition No. 3, for boards of ash, oak, and Scots elm, the Marquis of Breadalbane was again to the front with very fine clean boards, Sir John Stirling-Maxwell of Pollok being second with a very good lot. In Competition No. 4, for boards of any three non-coniferous timbers other than those specified in Competition No. 3, Mr Steuart Fothringham carried off the first prize with very good samples of scarlet oak, English elm, and beech; while Sir John Stirling-Maxwell came second with good clean boards of gean, beech, and black Italian poplar.

No competitors came forward in Classes 5 and 6, but in No. 7, for a gate manufactured from home-grown timber, there was

good competition. The first prize, a No. 2 Silver Medal, went to Sir John Stirling-Maxwell for a field-gate made of Scots pine of exceptionally fine quality, while the second went to Mr J. C. Archibald, Edenhall Estate, Langwathby, for a gate constructed of larch, also of exceptionally fine quality; but structurally this gate was inferior to that which gained the first prize. Mr A. Fraser, Lundin and Montrave, was third, with a gate of good design, also constructed of larch; and a No. 2 Silver Medal was awarded to Mr D. P. Wallace, Castle Hill Estate, North Devon, for a beautifully executed model of a field-gate. For a full-sized section of a rustic fence (Competition No. 8) there were two entries, and the first prize, a No. 2 Silver Medal, was gained by Mr Alex. Pollock, Tarbolton, with a fence of good design constructed in larch thinnings, while the second prize went to Mr A. Fraser, Lundin and Montrave, for an extremely neat design, but, constructed as it was of small spruce thinnings, the fence was not of such a durable nature as the other. In Competition No. 10, for examples showing the best methods of utilising small wood, the first prize, a No. 1 Silver Medal, was won by Messrs J. & E. Waters & Co., Ltd., Longtown, Carlisle, with an extremely well got-up case of bobbins; the second prize, a No. 2 Silver Medal, going to Mr Alex. Pollock, for plant-tubs, flower-vases, and a rustic table.

Of articles for exhibition only there was an interesting, if not very large, display, and from an educational point of view it was one of much value. The Society's set of 170 micro-sections of the timber of British-grown trees and shrubs, and collection of 100 lantern slides of photo-micrographs of plant tissues, presented by Mr D. F. Mackenzie, were again on exhibition. Some interesting exhibits illustrative of the growth of trees were shown. One of these, from Mr D. P. Wallace, Castle Hill Estate, North Devon, consisted of three boards each of larch and Douglas fir, and, according to the descriptive label accompanying them, the plantation from which they were taken, which consisted of 40 acres, was planted in 1867, the soil being a good loam overlying a thin, loose rock, known locally as "shillet." The crop was larch, with a Douglas fir here and there, and now the larch contain, on the average, 26 cubic feet of marketable timber per tree, while the Douglas fir contain 52 cubic feet. Lord Powerscourt exhibited boards of Scots pine, larch, and spruce of extremely fine, clean, and very

fast growth; and Mr Younger of Benmore had a nice lot of cross-sections of spruce, Douglas fir, *Abies Nordmanniana*, *Araucaria imbricata*, *Sequoia gigantea*, *Abies nobilis*, and oak. Messrs Alex. Bruce & Co., Leven, exhibited cross-sections of larch from the banks of the Findhorn. A nice collection of fourteen kinds of conifers, in tubs, was exhibited by Captain Stirling of Keir, and Mr Younger had a very extensive exhibit of branches of conifers, with cones, from Benmore. A small collection of tree seeds, and seedlings in pots, came from the Country Gentlemen's Association, London.

In the department of Forest Protection there were some excellent exhibits. Mr A. T. Gillanders, Alnwick Castle, had eight cases of insects injurious to forest trees, in which the complete life-histories of the insects were displayed; and Dr Borthwick, the *Honorary Cryptogamist* of the Society, had a set of five cases of both injurious and useful forest insects. From Pollok Estate came an extremely interesting lot of examples of damage by fungi, some fine specimens of *Trametes* and *Peridermium* being amongst them.

Of specimens illustrative of forest botany, a fine set of sixteen cases of specimens, with dissections of any the various parts of forest trees was exhibited by Dr Borthwick.

Tools and implements used in forestry were illustrated by a good collection of foresters' tools from Pollok Estate, and amongst other appliances exhibited may be mentioned Mr Kay's straining-pillar for wire-fencing, as well as a model of his tree-transplanting machine, and his dendrometer; and Mr J. Mactavish, Dunrobin, exhibited his calliper girth-measurer, for which he received an award at Dumfries, with some improvements.

Of timber treated with preservatives there was a good show. Messrs Alex. Bruce & Co., timber merchants, Leven, had a very instructive collection of creosoted examples, consisting of a field-gate made of Scots pine, railway sleepers of Baltic redwood, Scots pine, and larch, and small sections of seven kinds of common hardwoods and of four common conifers. In No. 7, timbers; and in every case the quantity of creosote injected was *per cubic foot* was specified.

Mr Leven, Auchincruive, Ayr, had an interesting exhibit of creosoted stobs and paling rails which had been in use for ten years, and which were still in an excellent state of preservation;

d regarding this exhibit the following note, embodying the bstance of the description which Mr Leven gave in the show-rd, is explanatory of the method of preservation employed:—

The exhibit comprised stobs, etc., of Scots pine, spruce, ech, ash, sycamore, poplar, willow, hornbeam and oak which d been in use for ten years, and were still in an almost perfect ite of preservation. The process of preservation was that vocated by Mr Leven in Vol. XVII. (p. 93) of the *Transactions*, d after ten years' experience of it, he was fully convinced of e efficacy, cheapness, and completeness of the system. He ntioned that he had a series of experiments on hand, but that ey were not far enough advanced to warrant his explaining em at that time. He had, however, come to the conclusion at seasoning to a certain extent was advisable, and that he d got an open shed (a corrugated iron roof on posts) erected jacent to the creosoting-tank, where the material to be treated uld be stacked for some time. It was not essential, nor even visable in the case of some woods, to season thoroughly fore treatment, as, he said, it was a mistake to suppose that osote closed up the "pores" of the timber (and this was me out in a striking way by the result of an experiment ried out by Mr Gillanders) in the same way that paint or did. The various properties of liquids—diffusion, osmose, ysis, cohesion, and probably capillarity—played parts, he ved, that had been overlooked in adopting certain systems reservation with creosote. He, however, emphasised the sity of stacking (under a roof if possible) the material after nent, as the displacement went on slowly for an indefinite . He also found that stobs stood driving much better his treatment, and that the volatile constituents of the e were thereby rendered less volatile. A number of ns were asked, and in answering them Mr Leven pointed t, in quantity, creosote was at that time very little over e per gallon, and that it could be had by contract for ably less.

othringham sent from Murthly two Douglas fir stobs d been in use for about eleven years, and which were the worse, an experience which tells very much in this timber for ordinary estate purposes. The fence h they were taken was partly stobbed with larch and Douglas fir, and the ground on which it was erected

is a dry gravel. None of the stobs were treated with any preservative, their points being merely charred and dipped in coal-tar. Mr Murray states that some of the Douglas fir stobs which have much sap-wood are somewhat decayed, but not so much so as the larch stobs, which were treated in the same way. Mr Murray also states that Douglas fir, like larch, does not creosote well.

There can be no doubt as to the value of these exhibitions from an educational point of view, and it is hoped that in the future all members of the Society who are in a position to do so will co-operate with the Council in their efforts to make them even more valuable in this respect than they have been in the past.

REPORTS BY THE HONORARY SCIENTISTS.

1. *Report by* A. W. BORTHWICK, D.Sc., *Honorary Consulting Cryptogamist.*

During the past year a considerable number of inquiries have been received and answered. Among other specimens sent in there were several examples of cankered Japanese larch, and in one case the trees had been very badly attacked by the larch aphis. Although the common larch canker-fungus has been known to attack the Japanese species for several years now, yet there are some who regard the Japanese larch as immune from attack, but, from the evidence as yet to hand, we cannot participate in such an optimistic view, and we strongly advise foresters to keep a sharp look-out for the first symptoms of disease in this species, in order that it may be checked in time, as prevention is always better than cure. It was no doubt due to lack of attention in this respect that the disease laid such a firm hold upon the European species, and became so thoroughly established and widely spread. Care should be taken that the Japanese larch is only planted in suitable situations, and in proper admixtures with other species; also that the young plants receive every care in transport and planting, so as to prevent any undue injury which is likely to reduce their vitality, or render them more easily attacked by the fungus.

Specimens of both the cortical and leaf forms of *Peridermium pini* have also been reported upon.

Two specimens of badly-cankered poplar branches were submitted during the winter. The disease in this case seemed to be identical with one very common in France, and attributed to the attack of a fungus called *Hyalopus populi.*

As a point of general interest we might mention the toothwort, or *Lathraea squamaria*, a specimen of which was sent in for identification. This is one of the flowering plants which has adopted a parasitic mode of life. It is parasitic on the roots of various trees, especially beech and hazel, at the base of which its fleshy erect stem, about a foot high, may occasionally be

met with. Its stem is creamy white in colour, and furnished with scale-like bracts, and dull, purplish, drooping flowers. Its underground portion bears white succulent fleshy scales, closely packed together, and its roots are fused with those of the host-plant, at the base of which it is found. There are no green leaves on the aerial portion of the stem, as such are dispensed with by a parasite, whose growth is not dependent on a supply of light, and this explains why the toothwort may be found growing in dense shade at the base of beech trees, even in a close wood. It cannot, however, be called a destructive parasite.

2. *Report by* R. STEWART MACDOUGALL, M.A., D.Sc., F.R.S.E., *Honorary Consulting Entomologist.*

THE OAK TORTRIX OR LEAF-ROLLER.

Tortrix viridana, Linn.

This pretty but destructive enemy of the oak belongs to the family *Tortricidæ*, a family of small moths that have a large wing-spread. The caterpillars live variously, according to the species, in rolled-up leaves, or internally in young stem or fruit.

The word *Tortrix* refers to the habit that some species of the caterpillars have of rolling or twisting up leaves. The manner in which the caterpillar manages to roll up the leaf has attracted the attention of various observers, and, as Dr Sharp points out, has been ascribed to "the immediate operations of the larvæ, to the contraction of the silk threads when drying, and to changes in the mode of growth of the attacked organ, due to the interference of the caterpillar."

Certainly the rolled-up leaf affords advantages to the caterpillar, which feeds under protection on the rolls, the excreme escaping by one of the open ends of the roll. Such excreme in the case of severe attack by the oak leaf-roller caterpil may be found strewing the ground, and is a means of cal attention to the attack.

The genus *Tortrix* is a very large one, and has a very distribution. Our insect, *Tortrix viridana*, is found in C Britain and Ireland, over the whole of Middle Europe, east Russia, and south into Italy. More an insect of level tra is yet found at considerable heights above the sea-level.

Description of the Insect.

Moth.—The moth measures about three-quarters of an inch in expanse of fore-wings. The fore-wings, sub-oblong in shape, are light green in colour, with light fringes round the lower edges. The hind-wings are light grey with whitish fringes. The under side of the wings is light coloured. The body is grey.

Caterpillar.—The caterpillar, which has the typical sixteen legs, is grey-green on hatching, but later is yellow-green; the head is black, and there is a dark patch at the tail-end. There are dark warts on the back. In length the caterpillar may reach half an inch.

Pupa.—The pupa is black-brown or black in colour, and measures barely half an inch.

Life-History.

The flight-time of the moth is in June and July. The moths are active fliers—flying also in the daytime. The females lay their eggs on the buds, or on the young twigs of older oaks, and these eggs remain unhatched until the next year, when, on the bursting of the buds, and the unfolding of the young leaves, the caterpillars issue. Flowers as well as leaves are destroyed. The young caterpillars feed on the under side of the young leaves, but later destroys older leaves, skeletonising them and eating them to the mid-rib. The caterpillars have the power of spinning, and if disturbed they can let themselves down on threads, and they let themselves down also by such spun threads to fresh feeding-places. When full-grown the caterpillar passes into the pupation stage under cover of a rolled-up leaf, or, if leaves be wanting, in a crevice in the bark or other suitable place, and the moth issues in three weeks. Attack is often very severe, and the result is loss of leaves, checking of growth, failure of acorn-production, and the dying off of branches here and there.

Protective and Remedial Measures.

Unfortunately, practicable measures of defence and remedy are scarcely possible, treatment being difficult, not only because of the activity of the moths and their ability to pass from oak to oak for their egg-laying, but also because the egg, larval

and pupal stages are all passed on the tree, and generally on older and taller trees, while the caterpillar attack, from the position of the eggs, begins from the crown, *i.e.*, the insect does not at any stage bring itself within easy reach of treatment. Insectivorous birds are useful allies of the forester, first against the eggs, and later against the caterpillars.

As regards other insects of the year, two very interesting sendings reached me, one from Mr Crozier, of *Megastigmus spermotrophus*, a Chalcid fly reported on elsewhere in the *Transactions*, and the other, of ash-shoots injured by the caterpillars of *Tortrix curtisella*. Mr Hugh Reid, who sent me the ash specimens for determination, wrote that the plants injured were young ash that had been planted out in the spring of 1903, and after doing well showed signs of attack in the next summer. The moth, whose caterpillars caused the injury—bud and leaf and shoot being injured—is a small moth, measuring in expanse of wings not more than 17 millimetres. It has a wide distribution, extending in Britain to Inverness-shire, and is also found in Ireland.

Of insects previously reported on, I received the pine-beetle, the wood-wasp, both *Sirex gigas* and *S. juvencus*, and winter-moth caterpillars.

In last year's *Transactions* I made mention of the attack on willows in Ireland by *Cecidomyia heterobia*. In response to a query, Mr M'Rae wrote me to say that the crop of "Norfolks" was again affected, but not nearly so severely as in the previous season, and while it was considerably under the average, yet what was got was mostly available for various working purposes.

NOTES AND QUERIES.

A NOTE UPON THE CRITICISM OF THE REPORT OF THE DEPARTMENTAL COMMITTEE ON FORESTRY IN THE PREFACE TO *The Forester*, BY DR NISBET—AND HIS REPLY THERETO.

My attention was called by Dr Nisbet to the views expressed in his book upon certain points in this Report and Evidence. His criticisms seem to me unsubstantiated by facts, and overstrained, even if they be taken in the light of an argument for Protection. The facts given in Dr Schlich's evidence as to the finance, situation, prairie value, quality of soil, stocking and management of the Anthonsthal Range are not disputed, and therefore Dr Nisbet's contention reduces itself to this—that the example in question, being so favourable, it should have been rejected by the Committee. But this example was only one out of several that are to be found in the Evidence—some of them bearing upon much larger areas—whilst the total German forest area and its net return are well enough known.

Moreover, the example given from the Anthonsthal Range could be superseded by even more remarkable figures. In the *Tharander Forstlicher Jahrbuch* are given the following averages of net annual revenue during the ten years 1894-1903:—

The net revenue of

	Per acre a year.
The ANTHONSTHAL Range has risen from 38s., as given by Dr Schlich, to . . .	43s.
The SOSA Range, of 3760 acres, has yielded .	45s.
And the CROTTENDORF Range, of 4078 acres, .	48s.

This shows, at any rate, that the Anthonsthal return is not the highest. It belongs to the Schwarzenberg Forstamt division, in which there are

46,812 acres, of which the mean net revenue per acre per annum is . . .	28s.

while the Marienberg Forstamt, with an area of

44,830 acres, yields a net annual revenue per acre of	30s.

so that the Schwarzenberg Forstamt is again not the highest.

The Report states (pars. 7 and 8):—"These (the various estimates of profit obtained in Britain) show that excellent returns . . . have often been obtained from plantations formed on land of little or no value for any other purpose."

Then it continues (par. 8):—"Dr Schlich gives corroborative evidence from the Continental forests." The Anthonsthal example was not put forward as an average result; the average results for the whole South German forests, for example, being given separately. The purpose of the Committee—and a very right one—was to indicate the results which are possible under good management, whilst, as the average price per cubic foot of the Anthonsthal timber amounted to 5½d. (excluding firewood), it is obvious that the favourable results are not due to high prices. The various industries established in these forests are indeed the product of cheap timber.

In Britain we have a highly absorptive market, but one which lacks good competition and careful preparation of timber to suit the market—wants that arise from the absence of scientific sylviculture, the possibilities of which are demonstrated at Anthonsthal; while as to Protection, a policy which, in the form of Colonial Preference, failed to promote sylviculture up to forty years ago—this affects the Saxony market in the form of a duty of 1s. 2½d. per 35 cubic feet, a rate which, if effective, reacts moreover on German exports in timber products. Nor in the matter of transport, in the case of Anthonsthal, is the distance of 3¾ miles between that range and the Bohemian frontier a long one compared with those traversed by our own imports. As to the comparative possibilities in sylviculture, my impression is that for paper and other industries we can grow spruce as well as in Germany, and if we cannot grow Scots pine so well, we can produce all the more valuable Coniferæ a good deal better.

R. MUNRO FERGUSON.

December 1905.

REPLY TO THE ABOVE.

If anyone will take the trouble to read pages 89 and 90 of *The Forester*, he will see that I was emphasising the fact that Continental data cannot be reliably compared with British data; that the economic conditions are entirely different; that the prices locally obtainable for timber may vary greatly from average prices throughout the country; and that, as a very

great difference between German and British conditions, in Germany "above all, there exists the absorptive market, prepared to utilise everything, including even small thinnings in large quantities—and *that* we have not got. A very good example of this—and of how misleading such data may sometimes be—is given in paragraph 8 of the recent Report," the case in question being Anthonsthal.

Now, at Anthonsthal the two great and deciding factors of demand and supply have long been working in almost ideal harmony; and the highly profitable results are mainly due to this favourable combination—although, of course, by careful management the growing-stock (and consequently also the annual fall) has been increased considerably during the last sixty-six years. But the exceptionally favourable balance of demand and supply is by far the chief influence in determining the good net income at Anthonsthal and similarly situated parts of Saxony, with the effect that this net income there obtainable per acre *is more than the double of the average for the whole of Saxony*, although the "good management" and the "accurate book-keeping" have been equally applied to all the forests in the country, and not merely to Anthonsthal and others which show exceptionally large returns owing to their exceptionally favourable economic conditions locally. This being so, I think that Mr Munro Ferguson is very far from correct in stating that my "contention reduces itself to this—that the example in question, being so favourable, it should have been rejected by the Committee"; but I do contend, as stated in the Preface to *The Forester*, that it appeared as if "incorrect conclusions had apparently been drawn . . . from evidence that was incomplete and therefore misleading," and I have there thrown further light on the point at issue. These remarks can be considered by the reader at his leisure.

As I have been thus attacked, I must now go further and assert that if the true facts of the case, as I have shown them to be in the Preface, were known to Mr Munro Ferguson and all the other members of the Committee—that Dr Schlich knew them is pretty certain—then that would have amounted to a *suppressio veri* and a deliberate attempt to mislead: but I feel convinced that this was not so, because, if he had had a full knowledge of all the facts and circumstances, it would have then been a case of the Chairman of the Committee, a pronounced

Free Trade M.P., in the Report to be laid before the House of Commons, quoting, as an example of the results of "good management," what he must then have personally known to be partly due to Protection; for it would be quite absurd to pretend that both the maintenance of the local monopoly in and around Anthonsthal, and the financial benefit thereby obtained, were not affected by the levying of *an import duty amounting to nearly* 8 *per cent.* [(35 × 5⅓) : 1s. 2½d. :: 100 : 7·78] *plus extra-haulage for a distance of at least* 3¾ *miles, and probably usually much farther.* To attempt to maintain that so high an *ad valorem* duty as 8 per cent., further increased by the additional cost of *extra*-haulage, on such a bulky and heavy raw material as timber, can count for little or nothing in the Anthonsthal balance-sheet would really be stating something that no unprejudiced person is likely to believe. Whatever the intention, however, the citation of Anthonsthal is clear evidence that Protection can and does there add in no small degree to the profit of timber-growing.

As to Protection with regard to timber-growing in Britain, I have never advocated it. Timber is such a heavy and bulky raw material, and so much of it gets wasted as sawdust, etc., during conversion, that it is one of the least suitable of raw products on which to levy an import duty. But the fact remains, that the complete abolition of the import duties on foreign timber in 1860 dealt the death-blow to the planting of waste land in the United Kingdom. In speaking of "Protection, a policy which, in the form of Colonial Preference, failed to promote sylviculture up to forty years ago," Mr Munro Ferguson is confusing various economic factors; but it is certain that duty-free imports since 1860, and increase of the burdens on land and plantations since then, have effectually prevented landowners from planting for profit. And, while on this subject, I may state my personal opinion here, that, if we can possibly obtain from Canada a preference for her exports of timber, wood-pulp, and paper made from wood, it will be of great advantage to Britain in the future.

In conclusion, I would ask Mr Munro Ferguson to read and consider the opinion of his own estate factor, Mr Meiklejohn, about Anthonsthal, when he visited it in June 1904 with Dr Schlich's party (see *Transactions*, Vol. XVIII., 1905, page 158):—

"To me this forest was particularly interesting. It extends over the same area as is covered by the Novar Woods, and the plan of cutting so many acres annually is in accordance with

the plan in operation at Novar. One thing, however, that accounts for the large revenue from such an exposed district is that there is a duty on all imported timber, which gives the forest a monopoly; and with the numerous mills already referred to in its immediate vicinity, it commands an excellent market for spruce for pulp-making."

This is an independent opinion, entirely corroborative of my own as originally expressed. And now I leave it to each reader to form his own opinion as to Mr Munro Ferguson's assertions that my "criticisms seem unsubstantiated by facts, and over-strained." After fully reconsidering them, I do not think this can truthfully be said of them.

J. NISBET.

THE DECLINE IN THE VALUE OF COPPICE-WOODS.

Coppice-woods, which formerly proved very remunerative to the growers, and afforded considerable employment to the rural population in the various counties in the south of England, have during the last decade, partly owing to foreign competition and partly owing to the scarcity of skilled labour, fallen in price at least 50 per cent.; in fact, hazel coppice, owing chiefly to the want of hurdle-makers, has become quite unsaleable. There is still a good demand for sheep-hurdles, which are as yet a necessity amongst farmers, but the latter will no doubt have to look out for a substitute for them in the future. The making of hoops in the wood from hazel and ash coppice-wood was another industry which paid well a few years ago; but, owing chiefly to foreign competition, there is now no demand whatever for these. Alder, birch, willow, etc., grown on marshy land, generally termed "gulley" wood, which is sold by the acre periodically (generally every nine or ten years), realised £10 per acre ten years ago, but now not more than £5 can be obtained for it. In fact, this last class of wood was quite a reliable source of revenue a quarter of a century ago; but, owing to changed conditions, it appears to have run its course, and it would seem that the next best thing to do would be to convert these crops into high-woods as quickly as possible,—an undertaking which would not be a costly one, more especially where good strong plants could be raised in the home-nursery.

W. STORIE,
Whitway House, Newbury, Berks.

The Prices of Timber in the South of England in 1904 and 1905.

The market value of timber is a matter regarding which vendors are frequently very much at sea, as they have, generally speaking, great difficulty in ascertaining what the ruling prices are, and a large amount of timber therefore is sold by auction or tender. The system of selling by auction and tender is not now so popular, however, in the south of England as it formerly was, one of the reasons for this being that timber merchants sometimes combine to keep down prices, in which case the auctioneer or vendor is at their mercy, unless, as sometimes happens, an outsider steps in and breaks up the ring. Sometimes, too, an extraordinarily high price is got for a particular lot of timber, and as news of this generally finds its way into the press, it creates a very misleading idea as to its real market value. In my own experience I find that timber merchants much prefer to give a fair price by private agreement, and not only is this an advantage to the vendor, as all unnecessary expense is thereby saved, but a great amount of extra trouble and anxiety is avoided, all that is necessary being good security.

My object in laying this note before readers of the *Transactions* is to point out the necessity for all parties interested in the selling of timber paying a little more attention to its valuation, and to the ascertaining of the ruling prices obtained for it for themselves, and of their depending less on the haphazard methods now so prevalent. A little more cohesion amongst parties interested in this matter would be very beneficial, and, in my opinion, the Arboricultural Societies are the proper sources through which this question should be brought under notice.

During the last two years trade has been dull, but notwithstanding this prices for the best qualities of timber have been well maintained. For second-class timber there has been a general falling off in price, and inferior classes have been practically unsaleable, excepting to local purchasers, the railway rates on this kind of timber being prohibitive for buyers at a distance.

The prevailing prices for 1904 and 1905 may be quoted as follows:—Prime clean oak, suitable for cleaving purposes, within a radius of 4 miles from a railway station and 60 miles from London, 2s. per cubic foot standing in the wood. Oak of a

rougher description, but sound and suitable for planking, 1s. 10d. per cubic foot; clean-grown ash, 2s. 6d. per cubic foot; beech, 20 inches on the side and upwards, 1s. to 1s. 4d. per cubic foot; English elm, up to 1s. per cubic foot. Good clean willow, suitable for cricket bats, etc., is readily bought up at 2s. 6d. per cubic foot; and hardwoods of small dimensions, such as beech, birch, lime, sycamore, horse chestnut, etc., bring 6d. to 9d. per cubic foot. Larch is becoming scarce, and from 1s. to 1s. 2d. per cubic foot is the ruling price standing in the wood; while Scots pine and spruce run from 4d. to 8d. per cubic foot, according to quality and dimensions.

W. STORIE,
Whitway House, Newbury, Berks.

PROFITS FROM TIMBER-GROWING IN HAMPSHIRE.

It is not by any means an easy matter to estimate what some soils will produce in the way of timber-crops, but from what has come under my own observation in parts of England and Scotland where timber-growing has received some attention the results have been most encouraging.

Of course, where no record of intermediate returns has been kept, one can only calculate what the crop of timber on the ground is worth, but an approximate estimate of income may be formed. For example, in the case of an oak plantation which has been properly tended, and on suitable soil, at 100 years of age, the value of the intermediate returns may be taken at about equal to the final fall, and the same may be said of healthy larch plantations at 60 years of age; while in the case of Scots pine and spruce at 80 years of age, these may be taken at one-half the final fall.

The following notes regarding prices obtained for timber on the Earl of Carnarvon's Highclere Estates, in North Hampshire, may be of interest.

Three acres of land were planted thickly with acorns about the year 1805. The soil was a strong sandy loam, on a poor sandy subsoil, not by any means what might be considered a good soil for oak. The timber, although of good proportions, was therefore not of the best quality, some of it being a little shaken. Notwithstanding this, however, the amount realised for the timber from this piece of land from 1901 to 1905 works

out at £450, or £150 per acre. There is no record of sales previous to the aforesaid period, but the returns must have been considerable, I should say one-half more. The timber was sold standing, by private agreement.

Four acres of larch, 52 years of age, on a light sandy soil, worth about 2s. 6d. per acre for agricultural purposes, sold standing, realised £420, or £107, 10s. per acre; and one acre of larch on similar soil, 80 years of age, sold standing, realised £210. In neither case was there any record of the value of intermediate returns.

The following are particulars of a small plantation on a strip of waste land, on a hard chalk and greensand formation, with a south-east exposure, which was formed in the autumn of 1894. The area was 3 acs. 3 ro. 14 pls., and the crop consisted of oak and ash, with chiefly larch as nurses.

Receipts for larch poles sold in 1905, . .		£60	0 10
Cost of plants and labour, . .	£32 11 0		
Thinning in the spring of 1905, including cost of delivery to station, and pruning hardwoods, . .	19 11 4		
		52	2 4
Leaving a net surplus of		£7	18 6

The value of the crop after thinning, exclusive of hardwoods, is £100, which is equal to £160 in the gross for ten years' growth, or about £40 per acre.

W. STORIE,
Whitway House, Newbury, Berks.

ROOKS FEEDING ON PINE BEETLES.

In the autumn of 1905 my attention was attracted by the movements of a flock of rooks among Scots pine trees in a wood near my house. The age of the trees (under 30 years), as well as the time of year, precluded any idea of nesting operations; yet it was evident the birds had some object in view, as they were observed to flit about among the tops of the trees for days. For some years the wood had been a good deal infested with pine beetle (*Hylesinus piniperda*), and a little close observation of the movements of the rooks revealed the fact that they were in search of the beetles, which had taken up their winter

quarters in the young shoots. The labours of the birds, it was quite apparent, were not in vain, as they could quite well be seen picking the beetles from the shoots, at times perched on twigs scarcely strong enough to carry their own weight, at others hovering on wing among the points of the branches. I have not hitherto heard of the much-maligned rook being regarded as a friend of the forester in this respect, and I think the incident worthy of record among the Notes in the Society's *Transactions*.

J. BOYD,
Pollok.

THE BIRCH AND ALDER SAW-FLY.

While combating an attack of pine saw-fly (*Lophyrus pini*) in a young plantation at Corrour, Inverness-shire, in the month of July 1905, my attention was called by one of the workmen to a similar attack among birch and alder, on the latter especially, in an adjoining plantation. These caterpillars at first sight seemed to be the same as those on the pines, the size and marking of the two bearing so close a resemblance to each other, especially when at rest, that the mistake of the workman in concluding they were one and the same was quite excusable. But on being disturbed, the caterpillars showed a marked contrast in their behaviour to those on the pines, for instead of clinging to the leaf with the sucker feet and raising the head, as is done by those of the pine saw-fly, they clung by the true feet and raised their posterior extremity, a phenomenon which was also frequently observed when they were feeding. I had some specimens forwarded to Mr Gillanders, who named it *Nematus*. I am not aware of this insect having been previously recorded in Scotland, nor is Mr Gillanders, although he informs me he has seen it in England.

J. BOYD,
Pollok.

EXPERIMENT WITH LIME AND ARSENIATE OF SODA FOR PROTECTION AGAINST THE PINE WEEVIL.

In the case of the lime experiment, the method followed was to put a handful of fresh-ground lime round the neck of each plant in one of the worst-infested portions of the plantation. This was done in May, but it did no good, and we had to gather the weevils in June, as many as sixteen being found on one plant,

though the average all over the plantation was about three per plant.

A solution of arseniate of soda, in the proportion of 2 ounces of the powder to 10 gallons of water, was also tried. This was painted over the plants, but, as in the case of the lime, with no beneficial result; and Ahlbottn's tree-protecting solution, applied in a similar way, also gave negative results.

Nothing that I tried seemed to inconvenience the weevils. I rolled some amongst the fresh-ground lime, and dipped others in the arseniate solution, but next morning they seemed to be as lively as ever. Trapping with fresh bark, and, in young plantations, picking them off the plants, and, more particularly, removing them from the sward round the necks of the plants for a distance of 6 inches from the stem, proved the most effective plan with us. The best *preventive* measure I know of is to burn as much of the rubbish as possible before planting the ground.

The year 1902 was the worst we have had. I got them that year in a plantation formed on new ground which is fully a mile from the nearest old fir-trees.

THOMAS NEILSON,
Birkhill, Clackmannan.

A FINE LARCH.

I send a photograph of a larch tree which was felled at Novar in November 1904, and as the tree was a particularly fine one, perhaps the illustration may prove of interest to the members of the Society. The tree was 123 years old, and the bole contained about 400 cubic feet of timber (quarter-girth measurement), being 82 feet long by 26½ inches on the side in the centre. The following are the girths of the first 40 feet, at 5 feet intervals:—

	Ft.	Ins.
At 5 feet from root, . . .	12	8
„ 10 „ „ . . .	11	5
„ 15 „ „ . . .	10	10
„ 20 „ „ . . .	10	4½
„ 25 „ „ . . .	10	0
„ 30 „ „ . . .	9	10
„ 35 „ „ . . .	9	8
„ 40 „ „ . . .	9	4

WM. MACKENZIE.

Russian Larch.

The existence of a very superior and plentiful growth of larch timber in the forests of Northern Russia is well known, as shipments have been made to this market from time to time over a number of years. It is therefore a matter of some surprise that a more regular trade in this wood has not developed, for the shipments made from the White Sea ports carry all the good qualities of larch grown in the British Isles, whilst being cleaner and in much larger sizes. Larch is such a useful wood for so many purposes that a trade ought to spring up for the Russian production when it becomes better known. We have recently seen samples, polished and in the rough, which go far to recommend it as a wood for shipbuilding, wood-paving, and also for outside work, on account of its durability. It can, we understand, be supplied in the round or sawn 6 × 12 ins. downwards, in specifications following closely the requirements of buyers. The free-on-board prices at present asked are, we believe, from £8 for the larger sizes and widths down to £6 for the smaller falling out sizes.[1]—*The Timber Trades Journal*, February 18, 1905.

Hungarian Ash.

This timber is rapidly becoming a considerable factor in the ash trade throughout the country, and as its qualities become better known, the demand is steadily growing. In comparison with English ash, the Hungarian timber has several points strongly in its favour, chief amongst these being its greater cleanness and freedom from knots. The trees are grown so closely in the forests that they grow rapidly upwards, and the young branches die off at once, leaving the stems clean and shapely, and when they are sawn up this absence of small inside knots is of great importance in cutting out shafts, poles, handles, etc. Another advantage is its white, milky colour and freedom from brown-heart, which is common in our native ash. The grain is dense and straight, and in the logs from the best districts it is of an exceedingly elastic character, and most admirably adapted for bending purposes. These logs, when first opened,

[1] That is, from 8¾d. to about 11¾d. per cubic foot.

turn pink like the best kinds of English ash, and can only be distinguished from English by their superior appearance.—Abridged from *The Timber Trades Journal*, February 18, 1905.

A New Tasmanian Wood.

The Tasmanian myrtle tree (*Fagus Cunninghamii*) has found a market in this country for fret-saw work on account of its density and superior carving qualities. For panelling and other work, myrtle wood will be found to be highly artistic, especially if allowed to remain unpolished, and would make a good substitute for cedar. Moreover, the wood is plentiful, and can be obtained in excellent dimensions, say up to 40 ins. wide, without a knot. There seems to be a good future for this wood if rightly worked. We hear that some years ago the wood (on account of its even wearing properties) was being used in Tasmania for railway lines, and gave every satisfaction until the steel rail came into use. If cut from a right altitude, and in the right season, myrtle wood should find a large market for pier-decking, and will overcome the difficulty of splintering that is said to be found in pitch pine, karri, and jarrah.—Abridged from *The Timber Trades Journal*, April 22, 1905.

Tupelo Wood.

Tupelo, or tupelo gum, belongs to the dogwood family, and to the genus *Nyssa*. Probably nearly all the tupelo put on the market is from *Nyssa uniflora* (*N. aquatica*, Marsh.), the largest of them, and known locally as large tupelo, tupelo gum, and cotton gum. It is a large tree, and is found in Southern Virginia, west of Missouri and Arkansas and south to the Gulf, and as far west as Neuces River in Texas, and attains its greatest development on rich, damp lands.

The lumber has been on the English market some eight years, but at first it did not meet with a favourable reception, owing to its being shipped too green, which caused it to sweat, discolour, and become dosed. It is now, however, finding favour. Electric case manufacturers have found it suitable

for their purposes, it being a cheap substitute for whitewood. It is an excellent wood for the turner, as it is not easily split; and it would be very suitable for light boxes, toys, etc. It holds paint well, but is not durable in contact with the soil, or when exposed to the weather. The wood is light when seasoned, and white to light brown in colour. It is suitable for most purposes where poplar or other softwoods can be used, is exceptionally free from knots, and has a nice surface; planes well, but has practically no figure. It is apt to warp a little, but this can be largely obviated if care is taken when drying. It is at present supplied to this country in boards and planks, and we believe that a future is looming up for this cheap and useful wood.—Abridged from *The Timber News and Saw-mill Engineer*, January 28, 1905.

Hickory Becoming Scarce.

The increasing scarcity of hickory in the United States has alarmed manufacturers of wooden vehicles to such an extent that, at a meeting of over 200 representatives of these manufacturers, the advisability of taking the matter before Congress was discussed. It is stated that hickory trees have recently been attacked by an insect which, it is said, is fast destroying that class of timber. "There are now but three States from which we can draw our supplies," said Mr P. F. Van Buren, of Evansville, Ind., "and hickory trees are becoming extinct in these States. The shortage of this article, which is the most essential component of a wooden vehicle, will probably necessitate a general rise in prices of all wooden vehicles."—*The Timber News and Saw-mill Engineer*, January 21, 1905.

Water in Creosote for Timber Preserving.

Mr E. H. Bowser, M.Am.I.C.E., has reported to the Louisiana Engineering Society that creosote used for timber preserving may contain 2½ per cent. of water without requiring any allowance to be made in the quantity injected; but in no case should the creosote hold more than 8 per cent. of water.

When the percentage lies between the limits stated, it is necessary to compensate for its presence by injecting into the timber a proportionately greater quantity of the oil.—*The Timber News and Saw-mill Engineer*, September 16, 1905.

A Gigantic Cedar of Lebanon.

Mr Devenish had, in September 1900, growing on his lawn at Little Durnford, Salisbury, a cedar of Lebanon measuring 19 ft. 9 ins. in girth. This is much larger than any reported on at the Conifer Conference, 1891, or by the Board of Agriculture in 1903.—Hon. Ed.

Trees at Auchincruive, Ayrshire.

Auchincruive was one of the estates visited by the Society on the occasion of their Excursion to South Ayrshire in 1901; but owing to want of time, and to unfavourable weather, one or two only of the larger and rarer of the trees there, which are so carefully preserved by the proprietor, R. A. Oswald, Esq., were seen by the party. A few particulars regarding the dimensions of some of them may therefore be of interest.

The Scots pine, Spanish chestnut, and beech given in the list form part of what are believed to be the remaining trees (60 to 80 in number) of what has been described as "the first attempt at systematic planting for the production of timber in Ayrshire . . . in the valley of the Ayr and the valley of the Doon." The Spanish chestnuts in particular are of great size, their contents ranging from 300 to 450 cubic feet, quarter-girth measurement, per tree. Their fruits ripen in average years.

The measurements given in the following Table were, with the exception of those initialed "G. L.," made by Messrs Renwick and Mackay, of the Natural History Society of Glasgow, on 25th September 1905.

G. Leven,
Auchincruive.

t of Tree.	Girth.	Height from Ground at which Girth was taken.	Remarks.
	ft. ins.	ft. ins.	
Fraxinus excelsior).	12 4	5 0	Bole, 30 ft. (G. L.).
axinus Ornus). On	4 5½	4 0	Bole, 6 ft.
(*Fagus sylvatica*). les Wood.	15 7½	5 0	Bole, 17 ft. Planted probably about 1700.
(*Fagus sylvatica*). les Wood,	14 10½	5 0	Bole, 17 ft. Planted probably about 1700.
ed (*F. s. hetero-* Drive,	7 11	2 6	Bole, 9 ft.
(*F. s. purpurea*).	12 6	3 0	Bole, 9 ft.
ond,	12 1½	5 0	
on (*Cedrus Libani*).	7 7	4 0	Bole, 14 feet.
(*Æsculus Hippo-* St Quivox Manse,	14 11	4 0	Bole, 12 ft. Spread of branches about 100 ft. (G. L.).
	14 10	5 0	
h (*Castanea sativa*). les Wood,	15 7½	5 0	Bole, 50 ft. Planted probably about 1700.
(*Ulmus montana*). n,	12 6½	4 6	Bole, 15 ft. (G. L.).
irpinus Betulus). es Wood,	8 2½	5 0	Bole, 12 ft.
europæa). Bowie's	9 6½	5 0	Height about 110 ft. (G. L.).
aris). Garden,	11 7½	5 0	Bole, 9 ft. (G. L.).
aris). Garden,	9 2½	5 0	Bole, 40 ft.
binia Pseudacacia).	8 4	3 0	Bole, 16 ft.
	7 10½	5 0	
ee (*Ginkgo biloba*).	4 0	4 0	Bole, 6 ft. Dying.
	4 2½	5 0	
(*Quercus Robur*).	12 11½	5 0	Bole, 19 ft.
(*Quercus Robur*). unt Charles Wood,	11 8	5 0	Bole, 22 ft.
Quercus Robur). unt Charles Wood,	11 4½	5 0	Bole, 43 ft.
(*Q. Lucombeana*).	10 5½	4 0	Bole, 8 ft. Spread of branches, 83½ ft.
	10 11	5 0	
Ilex). Garden,	9 7½	1 10	Bole, 4 ft.
sylvestris). Mount d,	10 11	5 0	Bole, 42 ft. Planted probably about 1700.
pectinata). East it Charles Wood,	11 9½	5 0	Bole, 40 ft.
eudoplatanus). On it to House,	17 5	3 3	Bole, 4 ft.
eudoplatanus). On	12 2½	5 0	Bole, 25 ft.
eudoplatanus). On	11 7½	5 0	Bole, 32 ft.
Ailanthus glandu- d of Auchincruive	4 7	5 0	Bole, 8 ft.
dendron tulipifera).	7 8½	3 6	Bole, 8 ft.
regia). Garden,	12 0½	3 2	Bole, 7 ft.
sequoia gigantea).	13 10	1 0	Height, 61 ft. Planted about 1870.
s Wood,	9 7½	5 0	

Forestry in Japan.

If we look at the surface of Japan, we find that almost 60 per cent. of the land is covered with forests. It took the Government several years thoroughly to study, classify, and survey these enormous forests, and to establish schools in forestry. Trees are now grown in Japan with scientific care all over the country, and that magnificent national asset will in future be exploited to the fullest extent. The State owns more than one-third of the forests of Japan, and as these were in a very bad state, a vast national programme was drawn up for adjusting forest areas to manageable proportions, constructing roads, draining, irrigating, replanting, etc., and after a careful estimate the sum of £2,400,000 was destined for that purpose. This heavy sum was to be furnished by the forests themselves, by the gradual sale of useless, badly-situated, or uneconomical small portions. The income from the State forests is at present ridiculously small, but profits are expected to increase regularly from year to year, in consequence of the measures which have been taken to insure a scientific development. Some of the most valuable trees of Japan grow very slowly; therefore the full benefit of the new forest policy will become apparent only after several decades, and the Department of Agriculture estimates that the net profits of the State forests will continue to grow until within a century these will have reached at least £7,000,000 per annum if the prices of wood remain absolutely stationary, an event which appears unlikely. By its forest policy the Japanese Government has secured a considerable and constantly-growing income for the nation.—*The Timber News and Saw-mill Engineer*, September 9, 1905.

Mexican Forestry.

About eight months ago the Mexican Government commissioned Mr Paul Hoffman, a distinguished German forester and scientific agriculturist, to make exhaustive experiments with the growth of forest trees in Mexico. He has planted in different parts of the country 120 varieties of forest trees—about 30,000. It is the object of the Government to transform

the treeless plateaus of Mexico into forests.—*The Timber News and Saw-mill Engineer*, April 15, 1905.

Artificially Coloured Wood.

During the last two or three years many factories have been built in Sweden for the manufacture of coloured wood furniture. The coloured wood industry began in Italy in the 17th century, and wood-colouring works came to Sweden during the Thirty Years' War; but until quite recently the method was used on a very small scale, and at first only dry wood was coloured. Now, by the method invented by an Austrian, Joseph Pfister, in 1901, the wood is coloured when fresh. The tree is cut while the sap is in action, and in the colouring process the dye is forced under heavy pressure into the wood, and replaces the sap. Until recently the non-poisonous and aniline dyes were used, but these colours fade a little. Now the manufacturers can colour lengths of 13 feet. Birch, beech, alder, maple, elm, and basswood are the best kinds of wood for the purpose; oak is not good on account of the tannic acid, and in spruce and pine the colour cannot be made uniform. The wood looks best when polished. The prices are as yet comparatively high, on account of the amount of waste, but improvements may follow; and with cheaper prices and more extensive use it is considered that coloured wood will give Sweden an important income. It can be used in furniture, panels, doors, and so on; and for outside work it does not require painting. For fitting ships and tramcars it is also being employed very successfully.—Abridged from *The Timber News and Saw-mill Engineer*, April 29, 1905.

The Seasoning of Timber.

In the *Zeitschrift für Architektur und Ingenieurwesen*, Professor Nussbaum discusses the best measures for seasoning timber and for preventing the growth of dry-rot and other diseases to which it is liable. He points out that for numerous

reasons it is inexpedient to fell the timber when full of sap, and there are many objections to the plan which has been recommended of leaving the felled timber for several years in the forest after it has been cut down, for it is then exposed to the attacks of various vegetable parasites and fungi which abound in such places. He advocates that directly the leaves or new fir-needles have been formed, those trees which are hereafter to be felled in the autumn should be ringed round by the removal of a wide strip of bark, including the bast and sap layers.[1] This would hinder the ascent of moisture from the ground, and would cause the foliage to extract from the trunk all the sap and liquid particles in the cells. This procedure, moreover, enables the wood to dry very rapidly after being felled, and then the log should be at once removed from the forest and stored in a dry situation for use. By emptying the sap-vessels in this natural way, the attacks both of animal and vegetable parasites, which prey on the juices, are avoided, and in practice this plan has been found to give most excellent results.—*The Timber News and Saw-mill Engineer*, August 5, 1905.

What is a Load of Timber?

Fifty cubic feet of oak, ash, birch, teak, greenheart, pitch pine, pine, and, in short, every wood but one, constitute a load.[2] The exception to this rule is wainscot oak, which has only 18 cubic feet to the load, and it is designated as a "wainscot oak load." Place does not alter these rules; that is, they obtain all over England.— Abridged from *The Timber News and Saw-mill Engineer*, January 14, 1905.

[1] This is what is known as "girdling" in India, which has from time immemorial been practised in Burma, to season teak on the stool for two or three years before felling, and to render it lighter and more buoyant for floating.—Hon. Ed.

[2] There appears to be some confusion here. A *load* of timber = 40 cubic feet in the rough (which means "square-of-quarter-girth measure" = nearly 50 cubic feet actual contents), and 50 cubic feet of squared or converted timber. The local load of beech in Bucks is 25 cubic feet. For railway transport a *ton* of timber is 40 cubic feet for hardwoods and 50 cubic feet for softwoods.—Hon. Ed.

Weight of Timber.

The Lecturer on Forestry at the University of Edinburgh would be greatly obliged for reliable figures indicating the weight per cubic foot of unseasoned logs of various species. It should, in all cases, be stated whether the logs were weighed with or without the bark.

The Royal English Arboricultural Society.

Since the issue of the last volume of the *Transactions*, His Majesty the King has been graciously pleased to command that in future the English Arboricultural Society shall be known as the "Royal" English Arboricultural Society, and the members of the Scottish Society offer their hearty congratulations to the members of the English Society on the bestowal of this mark of Royal favour.

Appointment to Forestry Lectureship.

The appointment of Mr W. F. A. Hudson, M.A., to the Lectureship in Forestry at the West of Scotland Agricultural College, Glasgow, was inadvertently omitted in the list which appeared in the *Transactions* for 1904 (Vol. XVIII. p. 234).

IMPORTS OF TIMBER INTO THE UNITED KINGDOM, 1905.

	Loads.	£
A. UNMANUFACTURED WOOD.		
1. Timber (Hewn):—		
Russia,	244,887	574,414
Sweden,	20,108	35,872
Norway,	54,278	99,809
Germany,	134,968	415,131
United States,	147,798	731,337
British East Indies,	39,636	588,941
Canada,	60,481	385,954
Other Countries,	36,904	409,690
Total,	739,060	3,241,148
2. Pit-Props or Pit-Wood,	2,120,116	2,237,745
Total (Hewn),	2,859,176	5,478,893
3. Timber (Sawn or Split, Planed or Dressed):—		
Russia,	2,120,520	4,962,192
Sweden,	1,522,399	3,442,227
Norway,	499,127	1,303,161
United States,	490,632	1,695,466
Canada,	1,160,169	3,266,591
Other Countries,	192,938	583,543
Total,	5,985,785	15,253,180
Total of Hewn, Sawn, and Dressed,	8,844,961	20,732,073
	Tons.	
4. Mahogany,	96,428	820,395
5. Other Hardwoods,	197,111	1,170,798
Total,	293,539	1,991,193
Total Value of Unmanufactured Wood,	...	22,723,266
B. MANUFACTURED WOOD.		
1. Furniture and Cabinet Ware,	...	577,427
2. House Frames, Fittings, Joiners' and Cabinet Work,	...	317,288
3. Other Sorts (including Woodware and Wood-Turnery),	...	1,073,481
Total,	...	1,968,196
Total Value of Wood Imports,	...	24,691,462

EXPORTS FROM UNITED KINGDOM, 1905.

	£
1. Furniture,	731,906
2. Other Woodwork,	481,562
Total,	1,213,468

REVIEWS AND NOTICES OF BOOKS.

The Forester: A Practical Treatise on British Forestry and Arboriculture for Landowners, Land Agents, and Foresters. By JOHN NISBET, D.Œc., formerly Conservator of Forests, Burma, Author of 'Burma under British Rule,' 'British Forest Trees,' 'Studies in Forestry,' 'Our Forests and Woodlands,' etc., and Editor of the Sixth Edition of 'The Forester' by the late James Brown, LL.D. Wm. Blackwood & Sons, Edinburgh and London, 1905. 2 Vols. Price 42s. net.

"Although based on the sixth edition of *The Forester* (1894), the book now published is in reality a new work, in which is incorporated, in a condensed and improved form, the essence of all the other books I have written on Forestry during the last thirteen years, together with much original matter, dealing specially with conditions in the United Kingdom."

Dr Nisbet thus unreservedly accepts responsibility for *The Forester* of 1905, at least so far as the main text is concerned, in his Preface to the book. One has to confess to a feeling of regret that *The Forester* of Brown has disappeared for ever, and that the teachings of Brown, M'Gregor and M'Corquodale are now of the past. Those leaders in arboriculture did their best according to their lights, and undoubtedly they left their mark on our woods and forests, for good or ill as the circumstances declare; but while British Arboriculture is second to none, our ideas of Sylviculture are still vague indeed. That the stupendous task accomplished by Dr Nisbet in the production of the present work may have the desired effect in improving our knowledge of sylviculture will be the wish of all who have the welfare of our land at heart.

The work consists of two volumes, and each volume is divided into three parts, the first volume containing the Introduction, The British Sylva, and Sylviculture, and the second the Protection of Woodlands, The Management and Valuation of Woodlands, and The Utilisation of Woodland Produce.

The introductory part extends to one hundred pages, and it

contains a vast amount of matter which is historical and legal, and which is probably not the least interesting reading. The history of forestry in Britain is divided into three periods:—The first period takes us from the earliest times to 1482, the second to 1850, and the third to the present day. In a racy manner the author deals with the transition from game-preserving and ornamental or arboricultural ideas to the production of timber of commercial value. Special attention is given to the Reports by the Royal Commission of 1786, the Select Committees of 1885 and 1889, and the Departmental Committee of 1902, on the condition and prospects of forestry at these dates. The criticism is not in every case favourable, and in summing up the results of the 1902 Committee, the author certainly does not do them justice when he says that they "did little else than endorse the conclusions of the Select Committee of 1885-87. . . ."

In dealing with the national-economic importance of woodlands the author appears as a statesman of no mean order, and while all who have given the matter due consideration will agree with him that the encouragement of existing wood-consuming industries, and the creation of new ones, must go hand in hand with any great increase of our woodland area, if it is to be a financial success, the method of bringing this about at which he hints, viz., fiscal changes, apparently does not at present commend itself to the majority of the inhabitants of these islands.

Whether there are still 3,342,000 acres of waste land plantable with profit is a point which need not be discussed; but the area given by Dr Nisbet is probably much below the actual amount, and indeed the 1000 feet contour line might be exceeded in very many places with probably better results than have been attained at lower elevations, as for example with the larch.

The second part deals with the British Sylva—Our Woodland and Ornamental Trees. This part consists of two chapters—Chapter I. concerning broad-leaved trees, while Chapter II. deals with coniferous trees. As the title suggests, both broad-leaved and coniferous species are treated from an arboricultural as well as from a sylvicultural standpoint. The first chapter, which is devoted to the broad-leaved trees, opens with a discussion as to which are indigenous to these islands, and which have become naturalised as denizens of our woodlands. Although this chapter deals with broad-leaved trees, still, we suppose for

convenience' sake, the indigenous conifers are mentioned along with them. The chapter is written with the view to describe the useful and ornamental trees of the British Islands, but the author clearly states that he can only give prominence to those of sylvicultural importance. He further says that for convenience the genera have been grouped in their natural families, although otherwise not classified according to any system of botany.

Much minute botanical detail is given concerning some of the genera and species.

Throughout the Sylva, it may be mentioned, the individual species are dealt with under six headings, viz., distribution, description, economic value, soil and situation, cultivation, and sylvicultural characteristics. Further, to the descriptions under these headings there is frequently added a Continental note.

The conifers are considered in Chapter II. The natural order *Coniferæ* is divided into four tribes or groups, viz., *Araucarieæ*, *Abietineæ*, *Cupressineæ*, and *Taxodineæ*, and short descriptions are given to show the differences between these four tribes. The author makes a slip, however, when he states that in the *Abietineæ* the buds are usually naked, and under the *Cupressineæ* he uses the term *Gemmula* in a rather unusual way.

The generic descriptions are mostly those adopted by Dr Masters in the Report of the Conifer Conference of 1891, and the specific descriptions are partly from Loudon and partly from Gordon's *Pinetum*. The useful and ornamental conifers are treated after the same fashion as the broad-leaved trees, and the forester will find the information given concerning the characteristics of the various species, as well as the locality and cultivation best suited to their needs, of much value.

The nomenclature of the conifers has always presented difficulties, both as regards the scientific and the common names of the different species, and it would be a great help to foresters and nurserymen were something like uniformity introduced.

Part III. treats of Sylviculture proper, or the Formation, Tending, and Renewal of Woodland Crops.

Chapter I., entitled, "The Scientific Foundations of Sylviculture," commences with a discussion of the physiology of growth and nutrition of forest trees. A physiologist might take exception to some of the statements made by the author,

but we will pass over this part of the chapter with the remark that it is intended to lead up to what follows as regards drainage and amelioration of unfavourable soils. This part of the chapter is treated in an eminently practical manner. The results of Continental experience, as given by Buckhardt, are here and there intercalated to illustrate the various measures and methods recommended. The forester will find much useful information to guide him in carrying out such operations.

In Chapter II. the general sylvicultural characteristics of British forest trees, and the different classes of woodland crops, are discussed, and Dr Nisbet deals in detail with the special peculiarities of our chief forest trees in relation to climate, soil, light and shade, shape of root-system, stem and crown, rate of growth, and regenerative power and longevity.

The question of normal density of timber-crops is very carefully treated, both from the Continental standpoint and as it affects home woodland crops.

The three definite forms of woodland crop—coppice, coppice-with-standards, and high-forest—are described in detail, and the chapter concludes with an examination of the relative advantages and disadvantages of the three forms of crop.

Speaking of highwoods, which are really the only form of woodland crop now of importance to us (in Scotland at any rate), Dr Nisbet emphasises what has hitherto been almost wholly disregarded or left out of account, even by the best of our practical foresters, namely, that highwoods can never lead to exhaustion or deterioration of the soil so long as this remains protected by a sufficient leaf-canopy; but that, on the contrary, especially in the case of such trees as Scots pine and spruce, which make small demands on the mineral strength of the soil, the nutrient salts in available form at the end of the rotation may be considerably in excess of the quantity which was present when the original crop was formed. We think it may safely be conceded that until within the last few decades, when the scientific methods of forestry followed on the Continent began to be studied in this country, the importance of maintaining a proper covering of foliage as a means of improving the forest soil had been entirely ignored in Britain. Many foresters who long ago rejected the older arboricultural methods in dealing with woods grown for profit, and who otherwise, perhaps, if given opportunity, would not have come far short of Continental foresters in their

practice, seem to have entirely overlooked this principle in forestry, the truth and importance of which are so clearly and forcibly presented by the author in this volume, as well as in former writings, as for example in that excellent little forestry classic, *Studies in Forestry*, which is largely drawn upon for this work. Dr Nisbet has done much to disseminate a sounder knowledge of such important principles in forestry as that to which reference has been made.

Chapter III. covers the subject of sowing, nursery-work, and planting. The author quotes from Continental authorities, and indicates various general principles observed in forming nurseries which may be equally applicable to British conditions. The practical work of forming nurseries, temporary and permanent, is sketched, and such matters as preparing the ground, manuring, sowing the seeds, and transplanting seedlings are treated in detail. Useful tables of quantities for the nursery are also given. The comparison of British and Continental methods of nursery-work and "schooling" of seedlings cannot fail to be of very practical interest to the British forester.

The latter part of this chapter deals with the preparation of ground for planting, and the various methods of planting out permanently into the woods. Dr Nisbet naturally gives prominence to Continental methods which, questions of cost apart, are perhaps the best; and although he does not actually condemn "notch-" or "slit-"planting of conifers, he seems to consider this method suitable only for light, sandy soils. These certainly do need but a minimum of preparation, yet the fact remains that large tracts of land in Great Britain, especially in the north of Scotland, have been very successfully and cheaply stocked with trees by this method, either by the single notch with the hand-planting iron, or by the double T notch with the common spade, seedlings or quite small transplants being in each case used. And these plantings are by no means confined to light, porous soils. Probably the success is almost entirely due to our relatively moist climate. An objection put forward by the author against notch-planting is that it distorts the root-system more than other methods of planting. It MAY lead to greater distortion of the roots than other methods, but it NEED not do so if the work is carefully done, *and only seedlings or small transplants are used.* Past experience has shown that distortion of the roots is more

generally caused by careless nursery-work than careless planting, and when plants so damaged in the nursery come to be set out in the woods, it is too late to remedy the defect, no matter what system of planting is adopted. That partial failures do sometimes occur in planting by the notch-system there is not the least doubt; and perhaps where notching is least successful is in the restocking of ground that has been cleared of a thin crop of light-foliaged trees—another argument in favour of maintaining a good canopy to the end of the rotation In such cases, if the ground is of a light, gravelly, or rocky nature, a very thick mat of coarse grasses and mosses takes possession of the surface; and if a dry spring or summer follows the planting, the surface vegetation may prevent all light summer showers from reaching the newly-planted trees. 'It is then essential that the surface should be broken up by the mattock or some such tool, but as seedlings can then be safely used in many cases, the cost of nursery-work can at any rate be saved, but the planting cannot be so cheaply done as when small transplants are notched into the ground. But while experience has shown that under average conditions notch-planting of small conifers has been wonderfully successful in Scotland, the method is, of course, quite unsuited to the setting out of larger plants.

In Chapter IV. such important matters are discussed as the selection of trees for woodland crops, soil-preparation before planting, the best distances for planting, planting of waste land generally, and planting of sand-dunes in England, Germany, and France.

Chapter V. covers the subjects of tending of woods and plantations, weeding and cleaning, thinning and partial clearances. General principles for thinning are laid down, and the various Continental methods are discussed. The question of pruning, and how far it is advisable in forestry practice, is considered in a sensible way, though probably few practical foresters would go any further in the way of pruning larch nursery plants than shortening back any contending leading-shoot.

The renewal of woodland crops forms the subject-matter of Chapter VI. It is shown that highwoods may be renewed by—(1) clear-felling with artificial regeneration, or regeneration by wind-blown seeds chiefly; (2) successive falls or partial clearances, and the successive falls by—(*a*) casual fellings, (*b*) fellings in patches, (*c*) regular partial clearances with uniform natural

regeneration. Full details are given of German and other Continental methods of regeneration.

Chapter VII. is, as the title indicates, "Concerning Arboriculture, or Planting for Ornament and Shelter."

There are many statements put forward in Part III. in regard to which there may perhaps be room for differences of opinion, but taken as a whole this section is one of the best, if not quite the best, in the book. It is a valuable contribution to a very important subject, and will amply repay close and careful study on the part alike of proprietor, factor and forester.

Part IV. consists of six chapters on the important subject of the protection of woodlands against inimical organic and inorganic agencies.

Chapter I., "Protection against Men and Human Actions," naturally resolves itself into a question of legal protection.

Chapter II., "Protection against Farm Live Stock, Game, and the Larger Kinds of Vermin." To a great extent the protective measures here consist in proper fencing, and the various kinds of fences, their suitability, construction, and upkeep are exhaustively dealt with. The damage done by the smaller rodents—squirrels, mice and voles—is carefully gone into. The kind of injury caused by each species is described in such a way that the culprit may be recognised by his work, and, having got so far, the application of the exterminative measures recommended may then be applied.

Chapter III., "Protection against Destructive Birds." On the whole, birds are more useful than destructive, the decidedly injurious ones being greatly in the minority. There are some which levy toll in the shape of seed and fruit, but the good they do more than makes up for such compensation.

Chapter IV., "Protection against Injurious Insects." The author first gives a general account of insect life and metamorphosis. The individual species are each dealt with under the headings of appearance, life-history, prevention, and extermination. Several very useful tables are added which the busy forester will find of benefit. Like other parts of the book, this chapter has been revised and brought up to date, and the proof sheets have been read by Dr Stewart MacDougall. There are many excellent illustrations to elucidate the text.

Chapter V., "Protection against Weeds and Parasitic Plants." What has been said of the insects may be repeated here. The

recognition of the different parasites, and the symptoms of disease and its prevention and cure, are all sufficiently dealt with and brought up to date.

Chapter VI., "Protection against Injurious Influences in Soil and Atmosphere," is the title of the concluding chapter of Part IV. This chapter is an exceedingly interesting and important one. Generally speaking, it consists of three sections —(1) Protection against non-parasitic diseases of trees; (2) Protection against wetness and aridity of soil; (3) Protection against injurious atmospheric influences. It stands to reason that the forester cannot do much to alter the unfavourable physical and climatic conditions of soil and atmosphere, hence protection resolves itself into a question of selecting suitable species and treating them in a manner suitable to the concrete conditions of the locality. The chapter commences with a very good discussion concerning pre-disposition to disease. This is followed by a description of diseases due to unsuitable soil and situation, which, together with the description of diseases due to external injuries, complete the first section. Protection against wetness and aridity of soil is principally a question of drainage on the one hand and the fixation of shifting sand on the other. Both these questions are dealt with in a very satisfactory manner. Finally, we come to protection against injurious atmospheric influences. Those injurious influences are wind, extremes of temperature, drought, aqueous precipitations, lightning, and atmospheric impurities. Each of these factors is considered in detail, and, where possible, remedies and preventive measures are described. The forester will find this a very useful chapter to consult in cases of difficulty.

Part V. of the work is devoted to a consideration of the Management and Valuation of Woodlands.

The first chapter deals with "The Theoretical Principles of Wood Management," the second with "The Measurement of Timber-Crops," and the third with "The Formation of Working-Plans, or the Practical Application of the Theoretical Principles." Chapter IV. deals with "Book-keeping on Woodland Estates," and Chapter V. with "The Valuation of Woodlands."

Of the British literature on the subject, Dr Nisbet draws upon Schlich, Brown, Grigor, and Bright, as well as upon his own writings.

In Chapter I. the author discusses what is implied in the term, "Normal Growing Stock or Capital in Wood," and the

essential requisites for normal conditions of growing stock. He considers the principles underlying the choice of sylvicultural treatment (whether highwoods, coppice, or copse), and also such practical matters as the selection of the kinds of trees to be grown as timber-crops, and the most profitable rotations.

Full details are given of the different methods of fixing the annual falls, and protective and severance falls are explained. Dr Nisbet concludes a highly interesting chapter with some sensible suggestions as to the best method of management of British woodlands under existing conditions.

The methods of measurement of timber-crops are fully described in Chapter II., measuring instruments are illustrated, and useful Yield and other tables from Continental sources are given.

Chapter III. deals with the Formation of Working-Plans, and the subject is considered under five heads.

1. General remarks concerning Working-Plans or Schemes of Management.
2. Data and Statistics requisite.
3. The Preparation of the Scheme or Working-Plan.
4. The Explanatory Report to accompany the Scheme of Management.
5. Control and Revision of the Results of Working.

The author shows that "The object of the Working-Plan is, so far as possible, to provide for the continuous yield of annual returns of about equal extent and value, and, so far as practicable, from about equal areas;" and he points out at the same time that this ruling idea in the Working-Plan must be subordinated to the first fundamental principle of forestry, namely, that the productivity of the soil must be maintained.

Private owners of woodlands may remark, perhaps, that many proposals which the author puts on record as essential for the successful working of woodlands are, in the light of existing British conditions, mere counsels of perfection; but Dr Nisbet evidently quite realises that Britain is not yet ripe for adopting German methods of forestry *en bloc*, and in framing this chapter on the Formation of Working-Plans, he endeavours to adapt the highly scientific methods of Germany to British conditions. In this he has attained to a very considerable measure of success, and this section of the book may well be recommended to the study of those having woods under their control.

The chapter on the Valuation of Woodlands is a very good

one. In the first section the formulæ required in actuarial calculations in connection with forestry are detailed; Section 2 discusses points to be considered in making actuarial calculations; Section 3 deals with the valuation of forest land; Section 4 with the valuation of growing crops of timber; Section 5 with the valuation of normal capital in wood throughout the working-circle; Section 6 with the estimating of the income derivable from woodlands; and Section 7 with the application of actuarial methods to forestry.

Useful Appendices to this part are—

1. Tables of Girths and Superficies.
2. Cubic Contents of Round Logs (British measure).
3. Average Yield Tables for Scots Pine, Spruce, Beech, and Oak in Germany.
4. Tables of Compound Interest and Discount.

Part VI. deals with the Utilisation of Woodland Produce, and under this head such matters as the technical properties, harvesting, transport, preservation of timber, and woodland industries are discussed.

The author nullifies a great deal of what he has previously said when he practically admits that "trees grown in our more open woods . . . are, although shorter in the bole and rougher in the top, more durable, of greater density and greater strength, than timber grown closely together, as it is in the well-managed Continental and in the primæval virgin forests," a fact, at least so far as the timber of broad-leaved trees is concerned, which is apt to be lost sight of in these days of advocacy of wholesale adoption of Continental methods. Among much that is of inestimable value in this part to the practical reader will be found passages describing operations that are primitive, customs that are obsolete, and tools and implements that have been improved on, in Scotland at least. The transport of timber is dealt with in a thorough manner, and ideas from every part of the world are presented. This is an important factor in determining where timber may be grown with profit, and its difficulties emphasise the need of local wood-consuming industries. While we keep under the 1000 feet contour line timber-slides will not be utilised to any great extent, and water-shoots or flumes seldom or never. Tramways have been used in this country for the transport of timber, and their use might with advantage be extended.

The preservation of timber is a subject that justifies the thoroughness with which it is dealt, and probably most of the methods in use are touched upon. Certain of the processes are described in detail, and, from the information given, readers should be able to judge for themselves of their efficacy. Altogether the subject as treated is practical, and at the same time scientific.

Chapter V. deals with Woodland Industries—estate saw-mills, preparation of wood-pulp and cellulose, making potashes and resin-tapping. As might be expected, estate saw-mills are most fully dealt with, and when it is said that such an authority as Mr D. F. Mackenzie is quoted from freely, the subject needs little further commendation. Much useful information is given on the subject of power, ordinary water-wheels, turbines and steam power being contrasted. Saws and other wood-working machines are illustrated and described.

There is little prospect of the wood-pulp industry becoming important as an outlet for British timber until our area is much larger than it is at present, and until we are prepared to go about our business in a methodical way, by keeping up a regular supply of timber.

Charcoal-burning is described, but it is more interesting than important, as although much practised in the past, it is now done only on a very small scale.

The other industries mentioned above are not likely to make much headway until we take a lesson from our Continental neighbours, and set ourselves to make something out of the *waste* that now goes to waste, and learn not to despise the day of small things, even if it is only the using of sawdust for "stuffing pin-cushions and dolls."

A. W. B.
J. F. A.
G. L.

Elementary Forestry. By CHARLES E. CURTIS, F.S.I. London: Estates Gazette, Ltd., 1905. Pp. xxiv + 288 + 30. Price 6s.

As Mr Curtis explains in his Preface, this is an elementary text-book not intended to deal with so large a subject as is included within the term "Forestry," but rather an introduction to the elementary study of those branches of natural science which have a special bearing on arboriculture, and the study

of which "tends to encourage that spirit of observation—that desire to know—which is so essential to a useful career."

The work is divided into forty-six short chapters, averaging only six and a quarter pages each, so that the beginner can never be fatigued by having too much of any subject at one time; and the chapters are conveniently grouped into eight sections, respectively dealing with geology and soil-science; growth, reproduction, planting, and treatment of arborescent plants; management, measurement, and realisation of timber-crops; the identification of trees; descriptive details regarding British forest trees, broad-leaved and coniferous (a section being devoted to each); insect pests; and parasitic fungi. There is a very thorough Index, occupying the perhaps disproportionate space of 30 pages, dealing with references to the matters contained in the 288 pages of letterpress.

As is, of course, very appropriate in a book on trees, the portions dealing with botany are largely in excess of those treating of geology and zoology; and the sections descriptive of the different shapes of tree-leaves, and the peculiarities of the chief kinds of British trees, occupy fully one-half of the volume. About 40 pages are devoted to insect pests, and the more important of these are described—the weevil, beetle, saw-fly, and bud-tortrix of the pine, the oak-leaf-roller, the larch-aphis, the ash-bark scale, the beech-coccus, the gall-flies, and the spruce-gall aphis. But only eight pages are devoted to the injurious fungi, and only one of these is described—though it is certainly that which has hitherto done the greatest amount of damage in Britain, the larch-canker fungus. The definition of a fungus as "a plant which depends upon another, or upon vegetable debris, for its sustenance" is incorrect, because (to give a homely example, such as every one may have often noticed) green mould will flourish on old boots kept in a warm, damp place, although these are neither plants nor vegetable debris. It would be more nearly correct, though perhaps not absolutely so, if one said that fungi were dependent on organic matter for their ability to vegetate.

This casual mention of organic matter leads one to regret that Mr Curtis has not also included chapters on organic and inorganic chemistry, because, both in its relation to plant physiology and to the decomposition of rocks and the preparation of soil for plant-food, chemistry is certainly a branch of

natural science, an elementary knowledge of which is at least as important to the forester or arboriculturist as geology, botany, or zoology. Indeed, if one were asked to compare the relative value of these four scientific bases of agriculture, horticulture, and forestry, chemistry is perhaps the most essentially necessary of them all. Perhaps Mr Curtis may therefore include a section on chemistry when a second edition of the book appears; and we hope it may not be long before this is required.

The volume is well illustrated, and forms a welcome addition to the growing literature on this subject. HON. ED.

The New Forestry, or the Continental System adapted to British Woodlands and Game Preservation. By JOHN SIMPSON. Sheffield: Pawson & Brailsford, 1903. Price 15s. net.

Although the second edition of *The New Forestry* was published in 1903, it has only now been submitted for review. It does not contain much new matter. As in the first edition, Brown's system of forestry, as set forth in *The Forester*, is subjected to a great amount of unnecessary adverse criticism, and on this Mr Simpson wastes much space which a man of his undoubted ability might well have devoted to a fuller exposition of the modern and more excellent way. Brown served his day and generation, but few would now seriously think of following his methods, and his book has been superseded by a scientific and practically new work. Mr Simpson also attacks Scottish foresters of the past for their ignorance (?) in planting Scots pine and spruce when, he asserts, they ought to have used hardwoods as a more paying crop, and he singles out Sutherlandshire, of all counties, as a case in point. Yet, in his chapter on "Species most Suitable for Planting as Timber-Trees in Great Britain and Ireland" (page 94), he says:—"Here, then, we have three species—Scotch fir, spruce, Weymouth pine, to which should be added the larch, making four species which supply by far the greater portion of the enormous quantity of timber used in this country, which could be grown more quickly and *probably as successfully and profitably as any other species in almost every part of the British Islands.*" Nor does he seem quite fair or very consistent in some of his remarks on Arboricultural Societies. For these and all their doings he professes lofty contempt, yet, when it suits his purpose, he does not hesitate to quote with

commendation (for example, at pp. 41 and 164) from their *Transactions* and records of their proceedings.

When so much has been said, however, it is freely acknowledged that Mr Simpson's book contains much that is readable and of great practical utility. He gives useful details on such important practical matters as fencing, road-making, nursery-work, and planting. A description is given of the methods of planting he has found most suitable in his practice, and no fault can be found with them, though it may be pointed out that what is suitable in one set of circumstances may not always be of equal advantage in another. But it is not too much to say that a careful perusal of Mr Simpson's book will be of very considerable use to a young practical man in want of authoritative guidance in many such matters of detail.

Mr Simpson's "Sylva" is perhaps a little confusing. In his "List of Species described," for example, at page 98, the true pines (*Pinus*), as well as the spruce and silver firs, are all given the common name of "fir," and the spruce and the Douglas and silver firs are given the generic name of "*Abies*," while, on the other hand (pp. 105, 107), all the true pines described are "firs," except the Weymouth pine.

The author's remarks on thinning and pruning are sensible and to the point, and he gives useful details of work in the cultivation of coppice and osiers. He has also a good chapter on "Valuing and Selling of Timber."

Altogether, we are sure this second editon of Mr Simpson's book will be welcomed by many interested in forestry, and no forester's library will be complete without a copy. J. F. A.

Future Forest Trees. The Importance of the German Experiments in the Introduction of North-American Trees. By A. HAROLD UNWIN, D.Œc. London: T. Fisher Unwin, 1905. Price 7s. 6d. net.

In the Preface to this work the author, who is Assistant Conservator of Forests in Southern Nigeria, and was formerly in the Forestry Branch of the Department of the Interior of Canada, states that the subject-matter appeared originally in German in the *Austrian Forestry Magazine*, and that his object in this translation is "to present in the most concise manner the results of numerous experiments, chiefly made in Germany, with

some American trees, most of which are known as ornamental specimens, but have not received due attention in forest plantations here. A great deal of misapprehension exists as to their value, and as Germany has done most of the experimental forest-tree planting, it is instructive to hear the consensus of opinion of that country."

The book is one of much interest to the forester, as it focuses the general results obtained from sylvicultural experiments with exotic trees not only in Germany, but in Austria, Great Britain, and Switzerland as well, though, as the author points out, the British experiments have not, "owing to lack of system," been attended with the best results.

The idea of introducing foreign forest-trees into Germany was awakened, the author states, more than a hundred years ago, and attention was first directed to the eastern parts of North America, whence some three hundred species of trees were introduced for experimental purposes; but owing to the experiments being carried out without a knowledge of the sylvicultural requirements of the timber-species, most of them disappeared from the forest. A few of these managed, however, to struggle through, and became important objects for the study of the American tree-species in Germany. The desire to have timber-species which in their soil-requirements were more modest, or which were more frost-hardy, than the indigenous species, as also the desire to cultivate something rare and foreign, which perhaps would yield a more valuable timber than the indigenous trees, caused, a century later, attention to be drawn to new experiments in the cultivation of foreign trees in Germany. These experiments were speedily put into practice, and, after a trial extending over twenty years, the author states that "the results are undoubtedly of great forestal value. The new introductions during this period have brought trees to Germany which excel the German species in modesty as to soil-requirements, in frost-hardiness, and in rapid growth; which partly equal the German species in timber-production, partly surpass them; so that there is a promise that Germany will produce, in the course of the next century, as much of the splendid American hickory, walnut, Douglasia, and white pine wood at home as she requires." And the author goes on to say that, "should the above promise not be realised, the blame must not be laid on the foreign trees, nor on the German soil, nor on the German climate, but rather on

German foresters, who mishandle their exotics or leave them to the mercy of the animals of the forest."

The book consists of three parts. In the first part, the importations of American timbers into Germany are given in detail; the second part gives the "General Results of the Plantation Experiments with American Trees in Germany, Austria, Great Britain, and Switzerland"; while the third part deals with the "Sylvicultural Characteristics and Treatment of the Various American Species of Trees."

In the experiments 55 species were used, 26 broad-leaved trees and 9 conifers from the eastern parts, and 1 broad-leaved tree (*Fraxinus oregona*) and 19 conifers from the western parts of the North American continent. As was to be expected, the species from the eastern parts have proved more frost-hardy than those from the Pacific coast-region, while those from the latter region have, on the average, proved the more rapid in growth. Summarising the results, the American species which are likely to prove of greatest value sylviculturally in Germany are locust (*Robinia Pseudacacia*), Weymouth pine, the Pacific and Colorado Douglas firs, and the Banksian pine; and next to these come the shell-bark hickory (*Carya alba*) and black walnut. Cypresses "are hardly likely to become of a greater general value," and such species of fir, pine, ash, oak, etc., as are closely related to the European species "may turn out useful for sylvicultural reasons in those parts of Europe in which these species of trees are not to be found, but in those localities where these kinds of timber already exist, the kindred exotics appear to be superfluous." In this category would be included, of course, such species as the white oak (*Quercus alba*), the American ash (*Fraxinus americana*), the American elm (*Ulmus americana*), and the red pine (*Pinus resinosa*). Such species as the Banksian pine and *Pinus Murrayana* seem, owing to their great frost-hardiness and to their very modest demands as regards soil-requirements, to be specially valuable for the afforestation of poor, waste land in exposed situations. A. D. R.

The Estate Nursery. By JOHN SIMPSON. Published by the Country Gentlemen's Association, Ltd., 1905. Price 5s. net.

In this little book there is not much that is really new, but the author, founding on the solid ground of his own experience,

is able to speak with well-assured knowledge, and gives concise and sufficient instructions on most of the ordinary branches of estate nursery-work, including seed-sowing, transplanting seedlings, planting cuttings, etc. His criticism of the "bent one-sided 'walking-stick handle' roots" of some of the public nurserymen's transplants is no more than just, but it is only fair to say that not all nurserymen are sinners in this respect.

We know from experience that the author's advice as to mulching seed-beds, etc., as a substitute for watering is most excellent, and it is a matter that has not received sufficient attention at the hands of practical men. His remarks on manuring the nursery are not, however, very consistent. On the ground that trees derive most of their food from the atmosphere, he holds (page 34) that very little manuring is necessary, yet immediately after, he very rightly recommends heavy dressings of leaf-mould, which, as every gardener and every nurseryman knows, is, in respect of combined chemical and mechanical effects, the best of all manures, but in ordinary forestry operations it cannot always easily be obtained.

The author puts forward the opinion that the strongest seedlings will always keep the lead, and produce the largest trees and crops of timber in a given space of time, and in a footnote he claims to have been the first to draw attention to the matter, in *The Gardeners' Chronicle*, 1904; but, if we mistake not, Dr Somerville discussed this important question very fully in an article on experiments with tree-seeds in these *Transactions* in 1897. J. F. A.

Vocabulaire Forestiere: Français — Anglais — Allemand. By J. GERSCHEL, Agrégé de l'Université, Professeur d'Anglais et d'Allemand à l'Ecole nationale des Eaux et Forêts de Nancy. Quatrième édition, revue et considérablement augmentée. Berger-Levrault & Cie., Éditeurs, Paris, 5 Rue des Beaux-arts; Nancy, 18 Rue des Glacis, 1905. Price 5s.

In the Preface to this edition of his *Vocabulaire Forestiere*, Professor Gerschel mentions that some years ago he proposed to the Inspector-General of Forests for India to add to the second edition of the book an English part, but that the Inspector-General thought this would necessarily be very incomplete, owing to the paucity of technical forestry terms in English. Since then a

considerable change has taken place, both England and America now possessing a pretty extensive forestry literature of a technical kind, and Professor Gerschel has therefore in this edition made the addition which he then contemplated; and he explains that the promise of assistance which he received from Professor Fisher, of Coopers Hill, to whom he acknowledges his indebtedness, enabled him all the more readily to decide on this course. Professor Gerschel has also incorporated in this edition a certain number of the terms used in connection with game and fish culture, since these are subjects of special instruction at the forest schools.

This small work on Forest Terminology will be of much service to students of forestry, as well as to others who wish to know the French and German equivalents for the many technical terms now used in English forestry literature. The book consists of three parts—(*a*) French—English—German; (*b*) English—French—German; and (*c*) German—French—English; and in each part the terms are arranged alphabetically, so that any one, the equivalent of which in either of the other languages is desired, can be found with ease. A. D. R.

Manual of the Trees of North America (exclusive of Mexico). By CHARLES SPRAGUE SARGENT, Director of the Arnold Arboretum of Harvard University. Houghton, Mifflin and Co., Boston and New York; the Riverside Press, Cambridge (Mass.), 1905. Price $6.00 net. (English Publishers, Archibald Constable & Co., Limited, London.)

As the author of the monumental work *The Silva of North America*, the greatest of its kind which has ever been produced, Professor Sargent has earned for himself a world-wide reputation, and has established himself as the greatest living authority on North American trees (and shrubs). But the *Silva* is a work the chief interest in which lies in its value to the scientist, and its great size and cost have placed it beyond the reach of all excepting the most affluent. Professor Sargent has therefore done a great service to lovers of trees generally in focusing the material of the *Silva* in a handy volume, which can be easily carried about, and which has been produced at a price which will bring it within the reach of most people who take an interest in American trees. In the *Manual* Professor Sargent has

described no less than 630 trees; and about 600 fine illustrations, the work of Mr Charles E. Faxon, the artist who was responsible for the magnificent drawings of the *Silva*, are interspersed throughout the text.

In the *Silva* Professor Sargent followed the systematic order adopted by English authors, but in the *Manual* he has reversed this order, and has adopted the arrangement of Engler and Prantl's *Die Natürlichen Pflanzenfamilien*, beginning with the *Gymnospermæ* (Coniferæ and Taxaceæ) and finishing with the Gamopetalous Dicotyledonous *Angiospermæ* (Ericaceæ to Caprifoliaceæ). Such an arrangement is unfamiliar to those accustomed to British works on systematic botany, and we confess we should have preferred the arrangement of the *Silva*, although some such arrangement as that of Engler and Prantl, being more in accordance with modern ideas, will no doubt ultimately be adopted. The nomenclature adopted in the *Manual* is that of the *Silva*, and as this was freely criticised when that work appeared, it will be unnecessary to refer to it here in any large measure. But as Professor Sargent has not given the synonyms in the *Manual*, English readers will have difficulty with some of the names. For example, the Douglas fir occurs as "Pseudotsuga mucronata, Sudw.—Douglas Spruce, Red Fir." Of course "Douglas Spruce" leads one at once to the plant the author refers to, but *Pseudotsuga Douglasii* and Douglas fir, the technical and the common names respectively which we have adopted for the tree in this country, nowhere occur in the book. To take another example, the tree commonly known in Britain as Prince Albert's fir, which is generally placed in British works either under *Tsuga Mertensiana* (Carr.), as in the Kew *Hand-list of Coniferæ* (2nd ed.), or *T. Albertiana* (Kent), as in Veitch's *Manual of the Coniferæ* (2nd ed.), occurs in the *Manual* under "Tsuga heterophylla, Sarg.—Hemlock," with no reference whatever to any of its synonyms, or to any common name but "Hemlock"; while *Tsuga Mertensiana* (of Sargent, not of Carriere) is the name applied, as is the case in Veitch's *Manual*, to the "Patton spruce" (*T. Pattoniana*, Engelm., in the Kew *Hand-list*). This mixing up of names is very puzzling, but it is rendered much more so when, as is the case in this *Manual*, no synonyms are given. It is difficult to understand, too, how *Abies Lowiana* (of Murray), which is recognised by British authorities either as

a distinct species or as a well-marked variety of *A. concolor*, should receive no notice whatever—would, in fact, seem from the *Manual* to be non-existent. But the merits of the *Manual* are such as to sink into insignificance any shortcomings it may possess, and the book may with confidence be recommended to English readers as a reliable guide to the trees of the North American continent. It is provided with a synopsis and an excellent analytical key to the families described, as well as with a copious glossary of technical terms, and a very complete index. A. D. R.

The Royal Forests of England. By J. CHARLES COX, LL.D., F.S.A. Messrs Methuen & Co., 1905. Pp. xvi + 372. Price 7s. 6d. net.

This is the latest volume of the series in course of publication as The Antiquary's Books. It is therefore, as thus indicated, more specially intended for the archæologist desirous of learning special details of the operation of the old forest laws, than for the modern forester who may wish to know what were the habits and practices of the arboriculturists in ancient times—after timber-growing became a branch of rural industry in England, from the fifteenth century onwards. Such a work as a comprehensive "History of Forestry and Arboriculture in England" has never yet been published; and there is little chance of its ever appearing, unless undertaken at the cost of some society specially interested in this matter.

Dr Cox's work deals principally with the ancient laws and their administration, and gives much curious information regarding the procedure and records of the three different courts of the forest—the Woodmote, the Swainmote, and the Eyre or Justice-seat. The only recently published works with which it has resemblance are Mr W. R. Fisher's *Forest of Essex*, which appeared in 1887, and the *Select Pleas of the Forest*, prepared by Mr G. J. Turner, and issued by the Selden Society in 1901. But it differs entirely from both of these in its far wider range, because even Mr Turner's volume deals mainly with forest law and procedure in the thirteenth century.

Dr Cox's book is divided into thirty chapters, of which the first seven deal somewhat briefly with the early forests, forest

courts, forest officers, beasts of the forest, forest agistments or grazing and pannage, hounds and hunting, trees of the forest, and later forest history—the early and the later general history (chapters i. and viii.) being given in 18 pages. For the general reader this is the most interesting part of the book, which occupies rather less than one-quarter of the volume, while the remaining three-quarters deal in detail either with individual forests, or with the royal forests county by county.

In any work of this class there are usually errors, omissions, and inconsistencies, that can only be rectified when a second edition may be called for. Thus, on page 1 it is said that "Dr Wedgwood seems to be right in considering 'forest' as a modified form of the Welsh *gores*, *gorest*, waste, waste ground; whence the English word *gorse*, furze, the growth of waste land": while on page 5 we are told, and this contradictory statement is correct, that "The term 'forest,' that had long been in like use on parts of the Continent, was then [after the Norman Conquest] introduced into England." Again, speaking of the fictitious forest laws of Canute (purporting to have been issued in 1018, though this is not stated), it is said that they were "termed *Constitutiones de Foresta*," and that they were a "Latin Code, in thirty-four brief chapters." Surely this Norman forgery was written in the Danish tongue, and only subsequently translated into Latin? The first genuine code of *forest laws*, as distinct from regulations applying to the royal hunting-grounds of the Saxon and Danish kings (tracts subsequently converted by William the Conqueror into *forests*), was the Assize of Woodstock, 1184. In the Index the references to "Assize of Woodstock" are pp. 11, 68, on neither of which the date (1184) is given, though it is casually recorded on page 48 in connection with greyhounds.

For the modern forester the chief interest centres in Chapter VII. —"The Trees of the Forest"; but, unfortunately, it only extends to seven pages. The most interesting point noted is that, as early as 1313, a difference seems to have been made between *quercus* and *robur*. "The precise meaning of *robur*, and in what it differed from *quercus*, is by no means easy to ascertain. The two terms appear side by side in almost every old forest account throughout England. . . . Probably it [*robur*] may usually mean an oak which has been pollarded; but is it not possible that *quercus* and *robur*, at all events in some forest

rolls, were the two indigenous varieties of oak, *sessiliflora* and *pedunculata?*"

In these early days the beech received little attention, and all that we are told about it is that "The beech is named with a fair amount of frequency in forest accounts; there were beech-woods of some size in Windsor, Pickering, Northamptonshire, and Clarendon forests, and it is often named in Hampshire records. The Windsor records show that beech was used for shipbuilding purposes." Nevertheless, the Forest of Dean, which probably comprised a larger compact mass of woodlands than any other royal forest, must surely have contained from time immemorial a considerable proportion of beech.

The work is well illustrated with quaint plates and woodcuts, and altogether it forms a very handy volume, throwing interesting side-lights on the forests, foresters, landowners, and rural population of ancient times. HON. ED.

Webster's Practical Forestry: A Popular Handbook on the Rearing and Growth of Trees for Profit or Ornament. By A. D. WEBSTER. London: Wm. Rider & Son, Ltd., 1905. Fourth Edition, enlarged. Price 5s.

This, the fourth, edition of Mr Webster's Handbook has been considerably enlarged, and the whole work has been brought up to date. New chapters have been added dealing with such matters as the afforestation of our waste lands and the education of foresters, and these chapters, coming as they do from one who has written so much on matters pertaining to forestry, and whose opinions regarding the whole question were considered of such importance as to justify the Royal Horticultural Society in selecting him to give evidence as their representative before the Departmental Committee of 1902, should furnish interesting reading, although we do not agree with everything the author says, nor can we concede that he is the originator of all the ideas which he puts forward. Besides being a useful contribution to our forestry literature, the book has a value of its own as a work of reference in such departments as seaside- and town-planting (in the latter of which the author is an authority), and several other branches of forestry and arboriculture which are less fully treated in some of the other works. It should form a part of every forester's library. A. D. R.

OBITUARY NOTICES.

In the course of the past year (1905) the Society has lost by death several prominent members. On February 27th Mr Patrick Neill Fraser, one of its oldest members, died; on September 7th Mr Pitcaithley was cut off in the fulness of his manhood; on the following day, September 8th, the death of Mr D. P. Laird took place with tragic suddenness; while the death of yet another prominent member fell to be recorded within the year, viz., that of Mr Robert Baxter, on October 20th.

Patrick Neill Fraser.

Although Mr Neill Fraser's chief hobby lay in another direction, and most of the time which he devoted to pursuits other than those directly connected with his business was spent in the furtherance of botany and horticulture, yet he took much interest in arboriculture, and at the time of his death was one of the oldest members of the Society, having joined it in 1857, three years after its foundation. For many years he took an active interest in the affairs of the Society, both as a member of Council and otherwise, and he gave valuable assistance in connection with the International Forestry Exhibition of 1884. But, as has already been said, it was in horticulture and botany that Mr Fraser found himself most at home, and he was a prominent member of the Royal Caledonian Horticultural and Botanical Societies, to the former of which he acted as Treasurer for many years, and also of the Scottish Alpine Botanical Club.

A. D. R.

David Pringle Laird.

Few breaches indeed have been made in the ranks of the Society which have caused such a blank as that produced by the lamented death of Mr D. P. Laird. Although, comparatively speaking, he was a young member of the Society, having joined it in 1890, no one, perhaps, during his period of membership,

had a longer spell of office, and few took a more active part in its affairs than Mr Laird. On the death of Mr Dunn he became Convener of the Excursion Committee, and it may truly be said that no more popular leader ever took the Excursion party in hand. Mr Laird served for a number of years at the Council Board, and on the Excursion and other committees, the Convenership of the former of which, owing to his business affairs claiming so much of his attention, he resigned in 1902; and he occupied the position of a Vice-President for one term.

Mr Laird was born in Edinburgh in 1853, and was educated at the Edinburgh Institution, one of his school-mates being Dr Nisbet, the Hon. Editor of the Society's *Transactions*. He entered the nursery and seed business of Downie, Laird, and Laing, of which his father was one of the partners, and at the time of his death he was the senior managing director of the firm of R. B. Laird & Sons, Ltd. In the early seventies he spent two years in Ceylon, and on his return to Edinburgh he resumed his connection with the nursery and seed business with which his family had so long been associated.

Besides arboriculture and horticulture, with the various societies connected with the latter of which he was closely identified, Mr Laird also took a deep interest in educational and other public affairs, and at the time of his death he was a member of the School Board and Parish Council of Corstorphine; and at all the meetings of the various bodies with which he was connected, his breadth of view, earnestness, and keen insight always carried much weight with his colleagues when difficult points had to be decided.

Amidst his many other calls, Mr Laird found much time to devote to charitable and benevolent work, and he spared no effort to promote the best interests of whatever he took in hand in this way; and among the many societies and clubs with which he was connected, none will miss him more than those devotees of the "roaring game" amongst whom he was so singularly popular. A. D. R.

Alexander Pitcaithley.

By the death of Mr Pitcaithley the Society has been robbed of one of its most energetic members. Whether in office or out of it, he spared not himself when important work had to be

done, and the fearless criticism and straightforwardness of speech which he brought to bear on the discussions he took part in, when he thought the occasion required it, will long live in the memory of his colleagues and friends, but only as outward evidence of his singleness of purpose, and of the intense interest which he took in the welfare of the Society. To him Forestry was the be all and end all of its existence, and he was impatient of anything which he considered to be outwith its legitimate sphere of work. But he took no narrow, parochial view of its aims, and with most of the schemes or proposals for widening the scope of its work and extending the sphere of its influence and usefulness he was in warm sympathy, and not least, perhaps, with the scheme which has just been given effect to, namely, the establishment of branches in some of the principal cities of the kingdom. In private life he was one of the most genial and kind-hearted of men.

Mr Pitcaithley was born at Dunkeld in 1857, and was trained in the Duke of Atholl's nurseries at Ladywell, whence he went as foreman to the Duke of Sutherland's estate at Dunrobin. A few years later he became head-forester on the Duchess of Sutherland's Cromarty estates, and subsequently he served in the same capacity on the Jardin Hall estate in Dumfries-shire. From there he went to Sudbourne Hall, in Suffolk, where he remained for some years, and thence he removed to the Scone estates of the Earl of Mansfield, where he succeeded the late Mr Bayne as wood-manager.

As a forester Mr Pitcaithley was well abreast of the times, and he held strong views regarding the necessity for improvement in our methods of growing timber for commercial purposes, evidence of which may be found in the statements which he laid before the Departmental Committee on Forestry in 1902, and which is published in the Blue-Book of the Evidence. His good work at Scone is too well known to require more than passing notice here, and it only needs to be added that it was much appreciated by his noble employer, and that in forestry matters his advice was much sought after otherwise.

Mr Pitcaithley served for several terms at the Council Board of the Society, and also on several of its Committees; and at the time of his death he was senior Vice-President.

A. D. R.

Robert Baxter.

Robert Baxter was born in 1838 at Oxenfoord, Midlothian. He received a good education at the Parish School, and afterwards served as an apprentice in the gardens at Oxenfoord Castle. From Oxenfoord he entered the nursery of Messrs Ballantyne & Sons, Dalkeith, where he remained three years. Here he obtained a good knowledge of nursery work, and during the three years he spent here, he made the most of his spare time by attending evening classes, and in otherwise improving his general knowledge. From Ballantyne's nursery he entered the Duke of Buccleuch's woods at Dalkeith Park, under the late Mr Gorrie, who was then the head-forester. Five years afterwards Mr Gorrie died, and Baxter now, in spite of his youth, became head-forester on the estate, a position which he held for thirty-nine years, till his death. Throughout his life Mr Baxter gave much of his spare time to the service of societies for intellectual and moral improvement, and more particularly to those devoted to the interests of the young.

Mr Baxter was elected a member of the Royal Scottish Arboricultural Society in 1871, and he was a life member for thirty-four years. For many years he took a deep interest in the Society, both as a member and at its Council Board, and he was particularly helpful to the Society at the time of the International Forestry Exhibition, held in Edinburgh in 1884.

As a forester, Mr Baxter's work was, generally speaking, of the ordinary routine kind, but to this there were many relieving incidents, and one of the last of these was the planting of trees in Dalkeith Park by His Majesty the King, on the occasion of his first state visit to Scotland, in 1903, and from whom he received an interesting souvenir in commemoration of the occasion.

James Whytock,
Dalkeith Gardens.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING.

PROCEEDINGS IN 1905—*Continued.*

THE GENERAL MEETING.

A General Meeting of the Royal Scottish Arboricultural Society was held in the General Meeting Room, beside the Members' Pavilion, in the Highland and Agricultural Society's Show-yard, Scotstoun, Glasgow, on Wednesday, 5th July 1905, at 2.15 P.M. W. STEUART FOTHRINGHAM, Esq. of Murthly, President, in the chair.

Apologies for absence were intimated from Sir Kenneth Mackenzie, Sir Thomas Gibson Carmichael, Colonel Bailey, Mr Munro Ferguson, M.P., Hon. Secy., Dr Nisbet, Hon. Editor, and others.

MINUTES.

The Minutes of the Annual Meeting, held on 10th February last, were held as read and approved.

ELECTION OF AN HONORARY MEMBER.

The President intimated that the Council had approved of the suggestion made by Dr Nisbet, that, in recognition of his distinguished services to Technical Education in Forestry, the Honorary Membership of the Society should be conferred upon REGIERUNGS-RATH DR KARL GAYER, Emeritus Professor of Forestry in the University of Munich. In his letter, Dr Nisbet mentioned that Professor Gayer, who for forty years was a Professor at the Bavarian Forest Academy, Aschaffenburg, and at Munich University (since the commencement of the Forestry

course there in 1878), where he fulfilled the highest office as *Rector magnificus* in 1889, only relinquished his professorial duties five or six years ago, on attaining the very advanced age of close on eighty years, and that he is widely known as the celebrated author of *Waldbau* and *Forstbenutzung*, two of the best works ever published on *Sylviculture* and *Utilisation of Forest Produce*,—the latter having in 1903 reached its ninth edition (under the collaboration of Professor H. Mayr, Gayer's successor in the Chair of Forestry at Munich University). On the motion of the President, the Meeting unanimously agreed to elect Professor Gayer an Honorary Member.

"THE FORESTER."

A further letter was read from Dr Nisbet, intimating that his new work, *The Forester*, would be published in September, and that on the fly-leaf would be the following inscription:—

To the
ROYAL SCOTTISH ARBORICULTURAL SOCIETY,
in commemoration of
THE FIFTIETH ANNIVERSARY OF ITS FOUNDATION
(1854-1904).

Dr Nisbet added that a presentation copy of the new *Forester*, for the Society's library, would be sent after publication in September. The Secretary was instructed to convey the thanks of the Society to Dr Nisbet for his two letters.

FORESTRY EXHIBITION IN THE HIGHLAND SOCIETY'S SHOW.

The SECRETARY submitted the Judges' Report, as follows:—

Report by the Judges on the Forestry Exhibition, held within the Highland and Agricultural Society Show Ground at Scotstoun, Glasgow, from 4th to 7th July 1905.

We beg to submit our Awards as follows:—

Competition No. I.

For Boards of Scots Pine, Larch, and Norway Spruce.

1st Prize,	. .	The Marquis of Breadalbane.
2nd Prize,	. .	W. Steuart Fothringham of Murthly.
3rd Prize,	. .	Viscount Powerscourt.

Competition No. II.

For Boards of any Three Coniferous Timbers other than above.

1st Prize, . . Viscount Powerscourt.
2nd Prize, . . Capt. Archibald Stirling of Keir.
3rd Prize, . . H. J. Younger of Benmore.

Competition No. III.

For Boards of Ash, Oak, and Elm.

1st Prize, . . The Marquis of Breadalbane.
2nd Prize, . . Sir John Stirling-Maxwell, Bart. of Pollok, M.P.

Competition No. IV.

For Boards of any Three Non-Coniferous Timbers other than above.

1st Prize, . . W. Steuart Fothringham of Murthly.
2nd Prize, . . Sir John Stirling-Maxwell, Bart. of Pollok, M.P.

Competition No. VII.

For Gate for Estate or Farm Use, manufactured from Home-grown Timber.

1st Prize, No. 2 Silver Medal, Sir John Stirling-Maxwell, Bart. of Pollok, M.P.

2nd Prize, } equal, Bronze Medal to each. { John C. Archibald, Forester, Edenhall.
3rd Prize, } { Alex. Fraser, Lundin and Montrave, Largo.

Special Prize—No. 2 Silver Medal—For Model of a Gate, D. P. Wallace, Castle Hill Estate, North Devon.

Competition No. VIII.

For Full-sized Section of Rustic Fence, made from Larch or other Thinnings.

1st Prize, No. 2 Silver Medal, Alex. Pollock, Tarbolton, Ayrshire.

Competition No. X.

For Examples showing the Best Methods of Utilising Small Wood.

1st Prize, No. 1 Silver Medal, J. and E. Waters & Co., Ltd., Longtown.

2nd Prize, No. 2 Silver Medal, Alex. Pollock, Tarbolton.

We have pleasure in reporting that the exhibits were in every way creditable to the exhibitors. The arrangements made by the stewards were entirely satisfactory, so that the judging was made comparatively easy. We were disappointed that there were not more competitors, considering the great encouragement given in this competition by the offer of such valuable prizes and medals. Competitors, whether prizewinners or not, would largely benefit by the experience gained in preparing their exhibits, and by having their goods and workmanship well criticised. We can only speak in terms of the highest praise regarding most of the exhibits submitted to us. They were, as a rule, taken from the best specimens of their kind, and in most cases were fairly well manufactured.

In Competition I., the first exhibit especially was of prime quality of timber, and was well handled. The fourth exhibit would have been farther forward had it not been that the sawing was badly done.

In Competition II., the first exhibit was outstanding, the timber being of rare quality, and in every way well manufactured. The other exhibits in this Competition were also fairly good.

The exhibits in Competition III. were all very good.

In Competition IV., the first prize was given to the best exhibit, but in our opinion the boards of English elm should not have been exhibited, and we would suggest that in future boards of ash, oak, or elm of any kind should be excluded from this Competition.

In Competition VII. there was a great variety of really good field-gates. The second exhibit was probably the best gate so far as timber was concerned, and it had the additional property of being self-closing, but the mountings were much inferior to those of the other exhibits.

In Competitions VIII. and X. there was more room for difference of opinion, and consequently more difficulty in arriving at a conclusion. The rustic fence by "Tally Ho" was very

neatly done, but we thought the small soft spruce was not worth the great amount of skilful workmanship that had been put on it. We therefore gave the prize to the fence exhibited by "Rustic," solely because it would last many times longer than the other. The same remark applies to the exhibits in Competition X. When the exhibits vary so much in kind, there is room for difference of opinion, and we thought both exhibits worthy of recognition.

Some of the articles sent for Exhibition only, deserve a word of praise.

Mr John Boyd, Pollok Estate, deserves commendation for the trouble he must have had in collecting so many deformed pieces of timber, showing clearly the many enemies which attack the trees. The working tools, also exhibited by him, were very instructive, especially to young foresters. The little model gate exhibited by Mr D. P. Wallace was very neatly hung, and worked very satisfactorily, and, with the approval of the Committee, we awarded a special prize for it. Special mention should also be made of Messrs Alex. Bruce & Co., for the interesting exhibition of creosoted timber submitted by them.

J. GRANT THOMSON.
JAMES KAY.
WILLIAM WILSON.

The Report was approved of.

The SECRETARY said they had just had an interesting lecture from Mr LEVEN on "Creosoting Timber," and he was glad to announce that the Committee had arranged that Dr BORTHWICK should give a short address in the Exhibition on Friday afternoon, on "The Recognition of Forest Trees by Seed and Seedling."

On the motion of the PRESIDENT, a hearty vote of thanks was accorded to the JUDGES and the EXHIBITION COMMITTEE, and to Mr LEVEN and Dr BORTHWICK, for their services.

REPORT BY THE JUDGES ON ESSAYS.

The Report of the Judges on the Essays received in competition was submitted, as follows:—

CLASS I.

(1) "The Prospect of Growing Timber for Profit in the United Kingdom." By "Alpha."

Award—No. 2 Silver Medal—ARCHIBALD E. MOERAN, Palmerston House, Portumna, Co. Galway.

(2) "Raising Windfalls." By "A Young Forester."

Award—Bronze Medal—THOMAS HALL, Forester, Moore Abbey, Monasterevan, Co. Galway.

(3) "Natural Regeneration of Scots Fir." By "Cortex."

Award—No. 2 Silver Medal—GILBERT BROWN, Beaufort, Beauly.

CLASS II.

(1) "The Propagation of Forest Trees and Shrubs." By "Embryo."

Award—No. 2 Silver Medal—JOHN M. MURRAY, Assistant Forester, Kingswood.

(2) "The Laying-out of a Mixed Plantation, and its Management for the next Twenty-five Years." By "Sylviculture."

Award—No. 2 Silver Medal—JOHN M. MURRAY, Assistant Forester, Kingswood.

(3) "The Laying-out of a Mixed Plantation, and its Management for the next Twenty-five Years." By "Excelsior."

Award—No. 1 Silver Medal—D. M. MACDONALD, Assistant Forester, Alnwick, Northumberland.

(4) "The Complete Preservation of Timber." By "Fac et Spera."

No Award.

The recommendations of the Judges were unanimously approved of, and, on the motion of the Chairman, a hearty vote of thanks was accorded to them.

EXCURSION 1905.

The Chairman said that there was not much to be said regarding the Excursion, which they all knew was about to take place. He believed that about seventy had intimated their intention of going on tour.

Excursion 1906.

The President said that the Council had received a recommendation from the Excursion Committee, to the effect that the district round Newcastle might be visited next year, but he invited suggestions from the meeting. Colonel Campbell of Achalader suggested that a foreign tour might be taken up next year, to some part of the Continent where the cutting of timber was being carried out. Sir Archibald Buchan-Hepburn moved that the matter be remitted back to the Council with powers, which was agreed to.

Collection of Statistics.

The Secretary mentioned that Dr Nisbet, the Society's Honorary Editor, had asked him to remind the Meeting of his (Dr Nisbet's) appeal, made at the Conference on Forestry Education at Perth, for the collection of useful statistics of British Forests, and referred them to Dr Nisbet's statement on the subject on page 60 of last year's *Transactions*.

Scottish National Exhibition, 1907.*

The Chairman drew the attention of the Meeting to the proposed Exhibition to be held in Edinburgh in 1907, and asked whether the Society wished to take any formal part in it. It was ultimately left to the Council to make any arrangement in connection with the matter which they thought desirable.

A vote of thanks to the Chairman concluded the business.

* Note.—The Exhibition has been postponed till 1908.

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

XXIII. *The Possibilities of Artificial Manures in Forestry.*[1]

By A. W. Borthwick, D.Sc.,
Honorary Consulting Cryptogamist to the Society.

The use of artificial manures in agriculture and horticulture has nowadays become so general that we may safely say its value is unquestioned and universally recognised; but it is only within comparatively recent years that any serious attempt has been made to test their value in forestry, and, like all experiments in connection with sylviculture, progress has of necessity been very slow. Nevertheless we are, at the present day, in possession of sufficient evidence to warrant a very hopeful outlook in the future. In the course of this lecture I hope to be able to show that the subject deserves serious attention on the part of all foresters.

Since artificial manures became so easily obtainable in large quantities, their possible value and utilisation in forestry has been tested. As far back as 1869 Dr Giersberg obtained highly satisfactory results in pine-tree nurseries with Peruvian guano. The year 1880 saw several important experiments begun in different German forests. Also at that time in Belgium artificial manures were, in many cases, used in the afforestation of large areas; also certain societies in Belgium and Schleswig-Holstein were testing the value of artificial manures in forest nurseries. The success which attended those earlier experiments created no little interest at the time, with the result that they were continued. In 1891 appeared Schwappach's publication on the use of artificial manures, and this was quickly followed (1893) by Oberförster Ramm's pamphlet on the use of manures in forestry, which gave a great stimulus to the subject. Further, many

[1] Lecture delivered at the Annual General Meeting of the Society, 2nd February 1906. The lecture was illustrated by numerous lantern illustrations.

articles appeared in the various forestry journals concerning the use of appropriate artificial manures, with the result that the question began to receive general attention.

In the present year Dr Fr. Giersberg has brought the matter up to date by the issue of a third edition of his pamphlet on "Artificial Manuring in Forestry," in which he shows that artificial manures may, with the greatest advantage, be used in the nursery and in the forest itself; in other words, he shows that trees at all stages of their growth can derive the greatest benefit by the judicious application of appropriate food materials to the soil, both in the nursery and in the open.

In order to make the matter perfectly clear, it is advisable that we should start by considering the question from its foundation. We know that the body of a tree, like the body of an animal, is composed of organic substances. This organic substance is combustible, and when burned a portion is converted into certain gases which escape into the air, while a certain incombustible portion remains behind as ash. Hence the plant-body is composed of combustible and incombustible materials. Until about the middle of the nineteenth century the ash constituents were regarded as accidental and useless in the economy of the plant, but nowadays we know that this view is only partly true. The ash may be made up of various mineral constituents—some of which are no doubt useless and accidental, while others are absolutely essential. Among other things, the ash always contains potassium, calcium, magnesium and iron, and we know that these elements are essential constituents of the food material, since, by means of appropriate culture experiments, it has been found that green plants will not grow healthily unless supplied with all of those substances. Further, by leaving out any one in turn from the food material offered to the plant, we learn the function which it is destined to perform in nutrition. Six of ten essential elements, viz., carbon, hydrogen, nitrogen, oxygen, sulphur and phosphorus form constituent parts of the living substance of the plant. Potassium appears to be necessary in the original formation of sugar and starch, as well as in the subsequent changes which these substances undergo in the body of the tree, although it does not form a constituent part of them. Iron is essential in the formation of the all-important green colouring matter of the leaves. Calcium is regarded as essential in the assimilation of carbon dioxide by the green leaves, and also in

neutralising and rendering harmless certain poisonous by-products produced by chemical changes in the interior of the plant. Each individual substance has a function to fulfil, and must not only be available to the plant, but it must be available in sufficient quantity, otherwise the development of the plant will suffer in proportion to the scarcity of any one of the essential elements. At the same time, the tree only requires a certain amount, and its total production is determined by those food materials which are present in minimum. This law of the minimum is the crucial point in all questions relating to the nutrition of plants; nor must we forget that the same law applies equally well to all factors which regulate the growth of trees, such as light, heat, and moisture. In order to satisfy this law of the minimum, it is not only essential that the requisite food materials should be present in the soil, but they must be present in a form in which they can be absorbed by the roots, hence we must know in which form these substances can be most easily made use of by the tree. This last point is a very important one, and is worthy of close attention by all growers of plants. The mere presence of any of these essential minerals in the soil is not sufficient, as it may occur, combined with other elements, in a form unavailable or even injurious to plant-growth, and herein lies the danger in relying too much upon a chemical analysis of the soil in determining its capability of sustaining different kinds of crops. We may liken the tree to a living machine with, it is true, an infinitely complex mechanism. Nevertheless, no matter how complex that mechanism may be, this living machine is incapable of doing any work unless certain external conditions are fulfilled. The external conditions, then, which cause the "machine" to work, in other words to grow, are, as already mentioned, a sufficient supply of light, heat, moisture, air, and mineral substances. These are the things which the tree requires in the formation of the combustible organic portions, living and non-living, of which its body is composed. This may all seem somewhat beside the point as regards the possibilities of artificial manures in forestry, but it is mentioned to emphasise and to direct attention to the fact that the raw food materials taken in by trees must undergo a process of building up into organic compounds or *food* within the plant, before it can be assimilated by the living substance. This all means a considerable expenditure on the part of the tree, and

anything we can do to help it in this respect will mean an increased production or output by the "machine" in the shape of timber.

The artificial manures suitable for these requirements are such as contain phosphorus, potassium and nitrogen; for example, basic slag, kainit and nitrate of soda. These manures have been tested and found to give very satisfactory results. Ammonium sulphate has also been used with great advantage in forestry. The cultivation of leguminous crops treated with basic slag and kainit, to be finally made use of as green manure, is strongly recommended in the afforestation of the worst classes of waste land.

When properly applied, these artificial manures have been found to give most satisfactory results. As regards the quantity, 3 to 4 cwts. per acre of basic slag and half that quantity of kainit will suffice, but even *double* these quantities may be used with advantage. If the soil is poor in nitrogen, about 1 cwt. sulphate of ammonia may be applied per acre. Where the physical qualities of the soil require improvement, artificial manures may be mixed in the compost heap, and later spread over the beds, or we may resort to green manuring in combination with mineral manure. This combination tends to make heavy soils milder and loose soils firmer, which is of great importance, especially in newly-formed nurseries. The basic slag may be applied either before or after the ground is broken up, and as there is no fear of it being washed out of the soil, it may be applied in the previous autumn. In any case it should always be applied eight to fourteen days before the ground is planted. Kainit must be applied at least three months previously, or, better still, in the preceding autumn.

When the soil is sufficiently rich in humus, these manures will then suffice, but when it is deficient in humus, green manuring is of the greatest value. The process is very simple. The soil is broken up and the manure added, at the rate of 6 to 8 cwts. of basic slag per acre, and about half that quantity of kainit. This may be added while the soil is being worked up, or it may be subsequently scattered over the surface. The breaking up of the soil and the application of the manure should take place in autumn. In spring, after a light surface wounding, the area should be thickly sown with the green manure crop. Leguminous plants of different kinds are used, but on the Continent lupine,

for various reasons, seems to be the favourite. The quantity of seed sown varies from 1¼ to 1½ cwt. per acre.

There is thus plenty of phosphorus, lime and potash for the vigorous growth of the nitrogen-collecting plant which can work with full energy, and extract the maximum amount of nitrogen from the atmosphere. This repays the liberal dose of artificial manures recommended, since the basic slag and kainit are not removed from the soil, but are returned with the green manure, and are still available for the future forest-plants. It is important that the lupines should be strong and vigorous. If they are not so, then sufficient nitrogen will not be collected from the air, and this deficit must be made good by the application of artificial nitrogenous manure in the form of nitrate of soda. When green manuring is not possible in the nursery, then the application of artificial nitrogenous manures is necessary. It is important that the young plants should develop rapidly—hence the best form of nitrogenous manure is nitrate of soda, applied when the plants are coming into or are in full vegetation.

Where the use of artificial manures in the nursery is unsuccessful, the explanation is generally to be found in their improper use. It is necessary here, as in agriculture, to know in the first place what substance the soil requires, and also in what form, and when it should be added. Further, the fault not infrequently lies in adding too little to cover the requirements of the plants for several years. Nevertheless there are those who maintain that plants raised in a nursery with a rich soil are not suitable for planting in poor forest soils. Some even go so far as to say that the nursery should consist of the very poorest soil, in order that the starved plants so raised should be better able to exist later, on the less fertile forest areas. This is a great physiological error. It is true that plants do not stand well a change from a mild, warm climate to a raw, cold one. At the same time there is no ground to suppose that well-nourished plants suffer more than badly-nourished ones. The success in planting depends principally upon the quality of the plants, and on the vigour of the stem- and root-systems; especially essential are plenty of fibrous rootlets. Comparative experiments have proved that the most rapid development and the best growth are to be expected from properly nourished plants, such as are raised in a nursery with good soil. It stands to reason that a strong vigorous plant, with a sufficiently developed root-system, is

better able to withstand the transplanting to a po than a half-starved specimen with a weakly develope system. The stronger plant, from the very fact that better developed absorptive organs, will obtain nouri where a plant with poorly developed absorptive organs starve.

Experiments which have been carried out in various nu in different Continental countries have shown in a very s manner that excellent results can be achieved by the artificial fertilisers. Not only are the plants larger and vigorous in their growth, but they show better balanc better developed shoot- and root-systems, combined with a freedom from disease and resistance to unfavourable c conditions. Also a regular and sustained yield is ob because the fertility of the soil is thus preserved. Several nurseries, in which the soil by repeated cropping had b worked out, and which were on the point of being aban were again brought up to their full yielding capacity year by the judicious use of a few simple artificial manure:

Since artificial manures can be used with such effect nursery, the question is, can they also be used in the affore of waste, barren land or exhausted soil which is no capable of bearing crops? Very poor soil must hav substances taken from it by the trees replaced in ord their growth may be sustained and increased.

As Dr Giersberg points out, it may not infrequently l that after the removal of a fairly good crop of trees f certain area, the replanting and restocking of the same found to be very difficult. The plants do not thrive, and b up becomes more and more necessary, and the expenses ir in ratio. The formation of a canopy is extremely difficu even if the establishment of the new crop is finally acl growth may cease entirely after twenty or thirty yea remedy for this has long been sought, and it was only r that one should expect the good effect of artificial manure nursery to be the same in the open.

From among the many experiments carried out in di parts of the Continent, which are described and illustra means of actual photographs in Dr Giersberg's valuable I select two, but many other striking examples could be ci

I. Experiment by the community of Bocholt carried out

the direction of the Kgl. Oberförster, Herrn Halleux. The experiment was started in 1894 on very poor heath land, which consisted mostly of grey and yellow sand, with extremely little organic matter. Five plots were laid down in order to test the value of the basic slag and kainit in varying quantities. Columns I. and II. of the subjoined Table give the varying quantities. The manures were applied in autumn before planting. In August 1903, that is nine years later, the plants were carefully measured. These measurements are shown in Column III.

	I.	II.	III.
Plot.	Basic Slag. Cwts. per acre.	Kainit. Cwts. per acre.	In 1903, 9 years old. Average Height. ft. ins.
I.	16	1·6	8 11
II.	9·6	3·2	7 11
III.	3·2	4·8	6 5
IV.	3·2	None	5 7
V.	Unmanured		4 3

On Plot III., which received the maximum of kainit and the minimum of slag used in this experiment, the plants are nothing like so good as on Plot I., where the proportions were reversed. Further, it was found that on Plot III. many plants died off in the first and second year, and for two successive years beating up was necessary. This was not found necessary on the other plots. Plot V., which was unmanured, showed many diseased plants attacked by rust, no trace of which was to be found on the other plots treated with the slag. On Plot V. all the plants were weakly, with short, yellow needles, and they gave no promise of future growth, while on Plots I. and II. the young pines had for four years formed a complete canopy. On Plots III. and IV. the cover was only partial. Plot I., which had got most slag, was by far the best as regards the height and health of the trees, which all showed a dark green healthy colour. The conclusions drawn from this experiment were that 3·2 cwts. of slag per acre is too little, and that 8 to 12 cwts. is more like the quantity. The effect of the kainit is not so striking.

II. Experiment by the community of Zolder, started in the year 1898, under the direction of Herrn Oberförster Dubois. The area was about 9½ acres in extent, consisting of heath land. This was broken up in January during dry weather, and the

manure applied in the same quantity. A small part received an extra amount. The whole area was deeply worked and divided into strips 16 inches broad, which were planted. These were separated by unplanted strips 28 inches wide. In trenching the soil the upper manured layer was turned down and the lower layer brought to the surface. The conditions on the manured and unmanured layers were otherwise identical. The following Table shows the result:—

MEASUREMENTS IN 1903.

Plants Six Years Old.	Unmanured.	Manured.
	ft. ins.	ft. ins.
Total height of largest, . .	5 3	8 3
„ „ smallest, . .	1 11	2 11
„ „ plants from middle of plantation, .	2 11	4 11
Average length of annual shoots, .	0 $7\frac{3}{4}$	1 $3\frac{3}{4}$
„ „ needles . .	0 $1\frac{3}{4}$	0 $2\frac{1}{2}$
„ „ lower branches,	1 $3\frac{3}{4}$	1 11

From the last column of the Table one sees how rapidly the cover would be established on the treated area, thereby killing out the heather, and keeping the soil in a fresh and favourable condition for the future growth of the trees.

Experiments were first tried in the sandy districts in Luxemburg, Holland, and Belgium, and also in Germany. In Holland and Luxemburg the matter received most attention. In Belgium and Germany the experiments were few and isolated. At the present time Belgium has the lead of all other countries. Since 1890 the Forest Department has encouraged and subsidised experiments in this direction. For example, if a Belgian community are willing to undertake the afforestation of waste lands, the State will cover a fourth to three-fourths of the cost. If a community desires to make manurial experiments, it is the duty of the State forest officers to help with advice, while the State supplies a large proportion of the necessary manure, and if the community desires to carry out experiments in their forests to clear up certain doubtful points, the State supplies not only the manure but also the plants.

The Belgian Government believes that the success of artificial

manures in agriculture warrants its application in the cultivation of trees, and that in the afforestation of heaths and sand-dunes the desired results are more quickly obtained by such means. Past results justify the opinion. In fact, it is said that in this connection Belgium is already past the experimental stage, and that the results already obtained indicate future procedure. The State aid given for this purpose has been thoroughly justified by the results achieved, especially by communities with large tracts of unfertile waste land. Their success has further stimulated private owners to follow their good example.

It may not be out of place to recall a few facts regarding the physical and chemical properties of the soil. The soil on which the higher plants vegetate is produced by the disintegration of rocks of different kinds. Rain, frost, the carbonic acid gas of the air and general weathering, together with the action of lower forms of vegetation, as lichens and mosses, bring about this disintegration. The soil therefore consists of small, solid particles formed by the breaking down of various kinds of rock in which the decaying remains of vegetable substances occur as humus. Each little particle of soil is surrounded by a film of water called the hygroscopic film, and the root-hairs of the higher plants come closely in contact, and even fuse with these solid particles, so that they cannot be detached without injuring the hair. The hygroscopic water, the carbon-dioxide of the soil, and the vital action of the root-hairs, tend to bring these solid mineral substances into solution, and it is only in this form that they can be taken in by the tree, since they have to pass through the membrane of the root-hair before gaining the interior.

Between the solid soil particles are spaces filled with air. This air is necessary not only for the roots, but also for the other living things which inhabit the soil, especially certain very important micro-organisms, which will be referred to presently. Any excess or loose water in the soil occupies these spaces and drives out the air, nor is this loose water of any use to the plant. The water which is absorbed is the hygroscopic water, or that influenced by the force of adhesion to the soil particles.

Having opened up the subject so far, let us next turn our attention to the property which the soil possesses of absorbing and retaining certain solutions, as this is a point of great importance, especially as regards the application of the various

salts or mineral manures. Different kinds of soil possess in varying degrees the power of extracting from their solutions and retaining certain inorganic substances, which are thus prevented from being washed down to the deeper layers and lost. Of all soils, sand possesses the least power of holding the various food materials; that is, they are more liable to be washed down and lost. The power of retaining these substances increases in proportion to the amount of clay present. This is why sandy soils are less capable of holding a store of available food material and are more easily exhausted than the heavier classes of soils. Potash, lime, ammonia and phosphoric acid are among the substances which are capable of being absorbed and held in the soil, and the more concentrated the solution, and the more of it that is added, the greater is the amount retained. In virtue of this property, then, the soil tends to absorb and hold plant food material, but its capacity for doing so is limited by the dissolving action of the soil-water, which tends again to bring these substances into solution, thus rendering them available for absorption by the plant. So, in this way, the soil tends to store up food material produced by the natural weathering of the rock, or artificially added as manure; and, on the addition of these substances, others are liberated, which are either absorbed by plants or washed down to the subsoil. Chemical combinations and decompositions are constantly in progress—fixing up some substances and liberating others for absorption by the plant. These processes further tend to bring substances into solution which are otherwise insoluble in water and unavailable for the plant. For example, lime and potash may replace each other in certain combinations, so that adding lime to the soil may mean more available potash for the plant, and, on the other hand, adding potash may ultimately lead to a greater absorption of lime. The power of absorption by the soil increases the more rapid and energetic these changes become. This simply means that a greater turnover is taking place in the soil; the material present in excess being stored up, and this is accompanied by a liberation of that which may be deficient. In other words, the greater the store of food material present in the soil, and the quicker these chemical decompositions take place, the greater will be the amount of food material at any time available for the plant, which is equivalent to saying the more fertile is the soil; and this desirable state of affairs can be

brought about by the addition of artificial manures in proper amount at the proper time and in the proper sequence. We must, however, remember that the action of artificial manure may be direct or indirect; that is, the ingredients it contains may be brought into solution and directly absorbed by the trees, or these substances may lead to double decompositions taking place, rendering material already present in the soil available for the plant. The former is the direct action, the latter the indirect action, of the added substance.

As already indicated, soil analysis, or even analysis of the plant itself, does not give us sufficient data regarding the quantity and kinds of artificial manures which should be added. This can only be found out, in the first place, by experiment with the living plant itself, and the experience so gained will indicate the plan to be adopted in other places with similar soils and climate.

Before leaving the important subject of the preparation of food material in the soil, let us for a moment consider the process of nitrification. Among the various nitrogenous manures, the only one capable of being directly absorbed by the trees is nitrate of soda. The nitrogen contained in the other substances, humus, green manure and sulphate of ammonia, must first undergo conversion into nitrites and then into nitrates before it becomes generally available for absorption. These important changes are brought about by the vital action of organisms living in the soil, the so-called nitrifying bacteria. If the chemical and physical conditions of the soil are such that the healthy development of these organisms is interfered with, then the supply of available nitrogen in the form of nitrates is seriously diminished. Without going further into the subject here, it may be sufficient to state that artificial manures keep the soil in a condition favourable to these very important organisms.

As regards the application and utility of the various manures, the following points may be of interest:—

Nitrogenous Manures.—Nitrate of soda is easily dissolved, and the solution is directly absorbed by the plant. Its effect is therefore very rapid, and if it is not immediately absorbed by the trees, there is danger of its being washed out of the soil; hence this salt should only be applied when the roots are in an actively vegetative condition, and, further, the quantity given

may, or may not, have succeeded in putting the matter in a different light. I leave this for others to judge, but before coming to any definite conclusion, I would earnestly ask foresters and those interested in the growth of trees to give the matter a trial, in the full conviction that the results will justify experiments in this direction. The argument might probably be raised that the use of artificial manures in forestry would not pay on account of the comparatively small return got from the forest, but, as Dr Giersberg has pointed out, probably these small returns are in many cases due to neglect of this important factor of production.

As stated at the outset, the whole question is a comparatively new one—hence the data at present available are somewhat limited, but there is no reason why the good results achieved on the Continent should not be repeated in this country. The benefits to be derived from a more rapid growth of the young trees in the nursery as well as in the open, the earlier establishment of canopy, and the quicker returns from thinnings, are sufficiently obvious without further comment. In addition to this, we have here a means of rapidly producing screens, windbreaks, and shelter-belts. Finally, the possibilities of artificial manures in arboriculture are equally promising. In town or country, in park or garden, ornamental trees, to properly fulfil their function, must be preserved in a condition of robust health and vigorous vegetation, and in order to maintain them in such a state we must see to their proper nutrition, and here again is indicated the possibilities of artificial manures.

XXIV. *The Planting of Waste Land for Profit.*[1]

By JOHN NISBET, D.Œc.

In view of recent publications, including papers read before this Society, no preamble seems necessary in the way of describing the national benefits ultimately obtainable from the formation of extensive timber-plantations to be managed on business principles. So far as economic considerations regarding the future are concerned, it seems to be the duty of the State to make adequate preparations and provisions for ensuring supplies of timber of home-growth; but, besides such direct action, something should also be done by the State to provide substantial encouragement to corporate bodies and private landowners who may be desirous of forming timber-plantations on portions of their estates.

That extensive plantations, formed and worked on business principles, would serve a substantial purpose in the general development of the country is self-evident; but what, up to the present, seems to have received little attention from the different advocates of planting is that any such scheme of national utility should be properly based on broadly comprehensive and systematic lines, capable of providing both for State-action and for the encouragement of private enterprise—because both of these cases can be provided for just as simply as either of them separately. Hence, as a practical contribution towards this important question, I wish to-day to consider the following points, as briefly as possible, in the hope that they may perhaps be found worthy of the attention of Government, because the recommendations about to be made deal specifically with the very important matters slurred over as "Minor Considerations" in the Report of the Departmental Committee on Forestry, 1902:—

1. What scope is there for planting with profit on the waste lands in the United Kingdom?
2. What encouragement has the State hitherto given towards such planting?
3. Can we learn anything of practical use to us from what has been done in foreign countries?

[1] Paper read at the Society of Arts on 24th January 1906, and reprinted by permission from the *Journal of the Society of Arts* for 26th January 1906.

4. What can the Government be reasonably asked to do in this direction by way of legislative amendments and administrative improvements, so as to provide efficient machinery for the acquisition and planting of waste land by the State, and the encouragement of planting by corporations and private landowners?
5. How should waste land be planted for profit?
6. What will be the probable cost of planting, and what are the prospective returns from the thinnings and the mature timber-crops?
7. What would be the national-economic effect of such plantations?

1. *What scope is there for Planting with Profit on Waste Land in the United Kingdom?*—There is now, and there has always been for centuries back, a wide field for planting for profit, but want of funds has ever been the chief obstacle to this. In 1810 Lord Melville urged upon the Prime Minister (Mr Percival) the desirability of planting waste land owing to the advance in the price of pine- and fir-wood, and in the demand for oak, and he estimated "that certainly not less than 20 millions of acres are still waste." This estimate corresponds with that made by various persons from time to time, and accepted by the Departmental Committee, 1902—"There is in these islands a very large area of waste, heather, and rough pasture, or land out of cultivation, amounting in all to 21 million acres, on a large proportion of which afforestation could be profitably undertaken." But the circumstances of landowners are much the same to-day as they were ninety years ago:—"Such lands, it must be owned, are sufficiently abundant, but the great expense and slow returns of planting are inconvenient to the majority of land proprietors. . . . The expense of planting is immediate and certain, the profit distant and precarious" (*Quarterly Review*, 1813).

That our waste lands and poor pasturages offer a wide field for planting is undoubted; but until the Land Statistics Department has compiled and published a statement of areas presumably suitable for planting, it is only a matter of rough conjecture to hazard any opinion as to what proportion can be planted with any reasonable chance of profit. On the basis of an examination made over several adjoining counties in S.E. Ireland, I should estimate that at present only about one-fifth

of the total area classed as waste land is plantable with a fair chance of profit—though this might easily be very much higher in localities within easy and cheap access of wood-consuming centres (such as coal-mining districts), and though ultimately the plantable area might also be largely increased when once such first plantations provided shelter, and created or improved a local demand for timber. A large proportion of our waste lands is above the 1000 feet contour line, and in the open, wind-swept, unsheltered condition of the country very little of this higher land can possibly be planted at present with any fair chance of profit; while there is also a large percentage of peat-bogs where no timber-crops will thrive until the bog is cut away so far as to allow the young trees to get their roots down into the mineral soil. It is just as impossible to grow timber with profit on deep bogs, as on bare wind-swept mountain slopes having little or no soil left on them.

Assuming, however, the total area now plantable with a fair prospect of profit to be about one-fifth of the waste land throughout the whole of the United Kingdom, this means that there is scope for planting to the extent of over $3\frac{1}{3}$ million acres (see Table), which can be begun as soon as ever funds are obtainable for this purpose from either public or private sources.

	Waste Lands.	Probably plantable with a fair chance of Profit.
	Acres.	Acres.
England, . . .	2,305,823	461,164
Scotland, . . .	9,374,512	1,874,902
Wales, . . .	1,250,813	250,162
Ireland, . . .	3,779,640	755,928
Total, . .	16,710,788	3,342,156

And this would mean a total investment of about £20,000,000 spread over whatever number of years (say 20 or 30 to 40 or 50) might be taken in completing operations (see par. 6). But, even if such a total area were well stocked, and the old portions mature, the yield would be less than half the amount of pit-wood timber annually required by our coal-mines alone.

2. *What encouragement has the State hitherto given towards the Planting of Waste Land for Profit?*—The only answer to this is—None at all. Provisions have been framed under the "Settled Land" and other Acts for permitting trustees to grant money for planting, but no State-encouragement whatever has yet been given; and, in fact, the reverse is the case, owing to the abolition of the timber-import duties. In 1848, some of the preferential duties on foreign timber were removed; in 1851, further similar changes were made; and in 1866, Mr Gladstone "swept away the last of the old vexatious duties on timber," when "the last tax on raw material vanished with the repeal of the duty on timber" (Morley's *Life of Gladstone*, 1903, vol. ii. pp. 68 and 200). Neither at these times, nor subsequently, was any sort of compensation given to landowners for such virtual depreciation in the value of their planting investments, previously made, and of a permanent nature not capable of being reconverted into money and otherwise invested; and, since then, legislation affecting rates and taxes, estate and succession duties, etc., has added to existing burdens, in place of offering encouragment to the planting of waste lands.

The real fact of the matter is that the nation is almost apathetic about timber. Improved communications by land and water, iron steamships and railways, and free imports have obliterated the memory of what a burning question the subject of timber long was in Britain. It was never a party question; for two hundred years it touched the vital interests of the nation too closely for that; and now, because it is non-party and non-political, it is almost absolutely neglected. And the direct consequence of this is that, even if large landowners had funds and desired to plant extensively (though few of them have, unless they also own rich estates or coal-mines, etc., because planting investments are usually unremunerative for about thirty to forty years), far from Government holding out any inducements to encourage them in this respect, the growing of timber is hampered with various restrictions that might easily be remedied by legislation. Yet the Houses of Parliament, the two great representative bodies of landowners in the United Kingdom, have never thought it worth while to compel Government, as they might do any time they liked, to give some sort of State-aid, or to relieve timber-growing of any of the financial disabilities under which this branch of rural

economy labours, and which often make all the difference between a profit and a loss with so bulky and heavy a crop as timber.

Without either direct State-assistance or, at any rate, substantial encouragement from the State, however, it is hardly possible that private landowners, as a body, will ever be in a proper position for either planting extensively, or for managing extensive plantations on purely business principles in the manner most conducive to the ultimate national-economic welfare of the country with regard to future supplies of home-grown timber. And certainly, if there be any national duty to perform in this respect, it is the duty of the State, and not of the private landowners. The State is the only landowner that never dies, nor is called upon to pay estate and succession duty, and it is the only landowner that can make large investments without being compelled to desire quick returns in the shape of income; hence the State is the only landowner that can be sure of remaining free from the temptation to thin timber-crops at an early age and to a great extent—or, in short, that can afford to grow the best classes of timber upon rational principles. Hence, too, the State is the only possible landowner that can be reasonably expected to create large compact blocks of woodlands to be formed and managed on business principles, with the twofold object of providing timber in the future, and of fostering and encouraging rural and wood-consuming industries.

3. *Can we learn anything of practical use to us from what has been done in foreign countries about Planting Waste Lands for Profit?*—We may with advantage consider briefly what has been and is being done in Italy, France, Prussia, and Denmark, but it is especially the operations in the last-named two countries that will be of most practical use to us, as the climatic conditions there approximate much more closely to our own than do those of the S.W. and S. of Europe.

[Here follow some statistical details similar to those given in the "Notes on Continental Forestry, 1904," on pp. 161-182 of our *Transactions* for 1905, which need not be reproduced.]

Though necessarily brief, the above notes may suffice to indicate that the action of foreign countries seems worthy of imitation by our own Government, even although this has never been run on such paternal lines as obtain on the Continent. The first and the easiest step that might well be taken in this

direction is to obtain and publish complete information concerning—(1) what has been done, (2) what is being done, and (3) what is about to be undertaken in future, in the way of planting of wind-swept waste lands in Denmark and Prussia, the portions of Continental Europe where climatic conditions most closely resemble those obtaining throughout the United Kingdom.

4. *What can the Government be reasonably asked to do in the way of legislative amendments and administrative improvements so as to provide efficient machinery for the Acquisition and Planting of Waste Land by the State, and the encouragement of Planting by Private Landowners?*—State-planting and State-assistance to private planters (which would logically imply the right to exercise a certain amount of supervision and control) are really two separate questions, each worthy of individual attention if space and time permitted. But they may conveniently be both combined, because efficient departmental administration suitable for dealing with either case can easily at the same time be applied to the other. And certainly, if any national effort worthy of the name is to be made in either or both of the above directions, steps must first of all be taken to provide proper departmental machinery, because such does not at present exist. The simplest, most efficient, and most economical way of doing this would be (1) to further amend the Board of Agriculture Acts of 1899 and 1903, so as to constitute a Board of Agriculture, Fisheries, and Forestry, with a special Forestry branch under the direction of an assistant secretary, and (2) to abolish the Commission of Woods, Forests, and Land Revenues of the Crown, by incorporating it into, and distributing its work between, the Board of Agriculture, Fisheries, and Forestry and the Board of Works and Public Buildings (which was constituted in 1832 to perform certain duties previously belonging to the Office of Woods and Forests).

At the first glance this may seem quite an unnecessary proposal, but examination will show it to be merely a move in the direction of efficiency and economy, and not a difficult matter to accomplish. The property vested in the Commissioners of Woods, Forests, and Land Revenues of the Crown consists of (1) woodlands and other portions of the ancient royal forests, and the minerals within the same, (2) agricultural estates, and (3) freehold house-property in London. Of these, (1) and (2) can be most efficiently and economically administered by a Board

of Agriculture, Fisheries, and Forestry, because State-planting should certainly begin with and include the waste land in the ancient forests,[1] while (3) can also be just as efficiently, and probably at the same time perhaps a little more economically administered by the Board of Works and Public Buildings. Each of these two Boards is directly responsible to Parliament through a Minister, whereas the Commissioners of Woods and Forests are not directly represented in Parliament.[2] Again, the Select (Parliamentary) Committee on Forestry, in their Report of 1887, found itself compelled to call attention to the "unskilled management" of the Crown woodlands generally, and another Select Committee was appointed to inquire into the administration of this Department. Although this Committee of 1889 reported, in 1890, that it found the administration by the Commissioners of Woods and Forests satisfactory, this could no longer be the case if there is to be any great national movement towards planting waste lands for future profit, because the Crown woods, forests, and waste lands must be practically subject to the same management and control as any and all other plantations that may be formed by the State or with State aid. And already the Board of Agriculture performs the functions of the Land Commissioners for England, and administers the Acts relating to the improvement of properties by limited owners (Settled Land Act, etc.; see below); hence common-sense, efficiency, and economy would all demand that the Crown woods and wastes should be treated in the same manner as State-acquired waste lands and State-aided plantations on land owned by municipalities, corporations, or private persons.

With regard to Ireland, where special attention has long been urgently called for, provisions have been made under the Irish Land Act, 1903, for the acquisition of waste lands by the State with a view to planting, though this only applies to any estate "in the main agricultural or pastoral" (sect. 10). The authority for this is contained in sect. 4, as follows:—

"(1) In the case of the sale of an estate, advances under the Land Purchase Acts may be made for the purchase, by any trustees approved of by the Land

[1] As most of these wastes are burdened by rights to commonage of pasture, however, planting could only take place where such rights can be acquired by purchase—in terms of a special Expropriation Act, if necessary.—J. N.

[2] The *Crown Lands Bill* introduced during April 1906 proposes to give the President of the Board of Agriculture the option of sitting *ex officio* as a Commissioner of Woods, in order to have direct representation in the House of Commons. The Bill is to be much amended in Committee, however.—J. N.

Commission, of any parcel of the estate to be held subject to the provisions of this Act, for . . . the planting of trees, or the preservation of . . . woods or plantations. . . . (2) An advance in pursuance of this section may be of such amount as the Lord Lieutenant may sanction."

And under sect. 12:—

"(1) The Land Commission may take such steps and execute, or cause to be executed, such works as may appear expedient for the benefit or improvement of estates or untenanted land purchased or proposed to be purchased under this Act. . . ."

If such a forestry branch be created under the President of the Board of Agriculture, one of its first obvious duties would be to arrange for the selection and enrolment, county by county, of all tracts of waste land, poor pasturage, or land out of cultivation, which may appear to be more suitable for planting than for any other form of utilisation. This work could perhaps be most expeditiously performed by a committee consisting of three members, one of whom would be nominated by the County Council, one by the larger landowners, and one by the Board. This would very soon furnish tolerably complete data regarding—

(1) The extent and the actual rental and capital value of all the poor land fit for planting;
(2) The suitability of soil and climate;
(3) The prospects of disposing of timber favourably in the future;
(4) And any and all other information likely to be of use with regard to planting, either by the State or by private persons.

These records would be complete for each county, so that each case could be considered on its own particular merits.

The next step required to be taken, after providing efficient departmental administration, is to provide funds (to whatever extent may seem necessary) for acquiring[1] and planting land, and for assisting private owners to plant. It is not likely that there would be any difficulty in passing an Act to provide for the reclamation and planting of waste and other lands out of cultivation, and in raising the money for a "Waste Land Planting

[1] Private landowners might, of course, object either to plant or to sell waste land suitable for planting. Such cases would be certain to occur in very large number. If, therefore, Parliament should decide that the welfare of the country demands the introduction of any national scheme of planting, legislation would be required to provide for the expropriation (on fair terms) of land wanted for planting, but not otherwise obtainable at fair market value based on past actual returns.—J. N.

Fund" by means of guaranteed 2¾ per cent. stock, much in the same way as is laid down for the Irish Land Purchase Fund in sects. 28 to 36 of the Irish Land Act, 1903, the management of the fund being vested in the Land Commission forming part of the duties of the Board of Agriculture, Fisheries, and Forestry From this fund all loans granted to private landowners for planting (under the Settled Land Act, 1882, or other Acts; see below) could be issued at the rate of 3 per cent. without any loss to the nation as lender and with much advantage to the landowners as borrowers.

Under the *Local Government (County Council) Act*, 1888, sect. 65 gives "Power to acquire lands," while sects. 79 to 82 provide for the appointment of a Committee with power to acquire land and make regulations for the proceedings of Committees. But new legislation in the form of a Bill *for the Improvement of Woods and Plantations and the Planting of Waste Land* will, of course, be necessary to obtain any satisfactory enactment regarding the extensive acquisition of waste land for planting, and the formation of a "Waste Land Planting Fund" and of a Forestry branch of the Board of Agriculture and Fisheries.

Among the existing disabilities and discouragements to planting which require to be removed before there can be any reasonable hope of inducing municipal, corporate, or private landowners to plant extensively, the following matters may be specified as those which ought to be dealt with either by legislation or else by improved administration, or by both of these means:—

(1) Want of funds.
(2) Valuation of woodlands and plantations for estate and succession duties, and for local rates.
(3) Risk of damage by rabbits.
(4) Higher railway charges than for foreign timber.
(5) Risk of fire caused by railway-engine sparks.

(1) *Want of funds* has always been the chief obstacle to planting, and monetary assistance is the form of State-aid now most required by corporate bodies and private landowners desirous of planting for profit.

Under the Land Improvement Act, 1864, the improvement of land by planting was confined (sect. 9) solely to "Planting for Shelter"; and owners of land were only able, with the sanction of the Commissioners for the execution of the Act, to charge their estates for the planting of woods and trees in cases where

this was for the express purpose of providing shelter. By the Improvement of Land (Scotland) Act, 1893, this limitation was removed so far as Scotland was concerned, and similar assistance has been provided for England under the Settled Land Act, 1882, so that applications may now be made to the Board of Agriculture for sanction to charge estates with the cost of planting, whether for shelter or otherwise. And, subsequently, the Improvement of Land Act, 1899, amended the Improvement of Land Act, 1864 (which applied to all the United Kingdom), and extended to Scotland so much of the Settled Land Act as related to improvements, so that money borrowed may now be repaid by a rent-charge extending to a period not exceeding forty years;[1] but as even quick-growing conifer crops may often, under good management, take longer than that to mature, this period might well be extended to forty-five or fifty years.

With regard to entailed estates, provision is made under the Settled Land Act, 1882, for the capital being loaned by trustees for improvements such as planting. Sect. 21 authorises that "Capital money arising under this Act" may be given "(iii.) In payment for any improvement authorised by this Act," and sects. 25 to 30, dealing with the improvement of settled estates, give full authority for the spending of such capital on all works of drainage, enclosure, clearing, trenching, planting, road-making, etc., necessary to carry out planting operations in a complete manner. But sects. 26 and 28 distinctly direct that such schemes of improvement shall be based upon some sort of definite working-plan to be properly adhered to, so that the plantations may be treated on business principles.

"Sect. 26.—(1) Where the tenant for life is desirous that capital money arising under this Act shall be applied in or towards payment for an improve-

[1] The money expended on improvements and all expenses may be charged in one sum on the estate. The loans under the Scottish Draining and Improvement Company's special Act are repayable by instalments during any period not exceeding twenty-five years; and the rent-charge, to repay capital and interest within that period, is at present £5, 19s. 1d. per cent. per annum, payable half-yearly, for advances of £300 and upwards, and £6, 14s. for advances under £300. Under the Improvement of Lands Act, 1899, the Board of Agriculture may extend the period of charge to forty years, in which case the annual rent-charge for sums of £300 and upwards is at present £4, 11s. 6d. per cent. per annum, payable half-yearly, and £5, 8s. 3d. for advances under £300.

ment authorised by this Act, he may submit for approval to the trustees of the settlement, or to the Court, as the case may require, a scheme for the execution of the improvement, showing the proposed expenditure thereon.

"(2) Where the capital money to be expended is in the hands of trustees, then, after a scheme is approved by them, the trustees may apply that money in or towards payment for the whole or part of any work or operation comprised in the improvement, on—

(i.) A certificate of the Land Commissioners certifying that the work or operation, or some specified part thereof, has been properly executed, and what amount is properly payable by the trustees in respect thereof, which certificate shall be conclusive in favour of the trustee as an authority and discharge for any payment made by them in pursuance thereof; or on

(ii.) A like certificate of a competent engineer or able practical surveyor nominated by the trustees and approved by the Commissioners or by the Court, which certificate shall be conclusive as aforesaid; or on

(iii.) An order of the Court directing or authorising the trustees to so apply a specified portion of the capital money. . . .

"Sect. 28.—(1) The tenant for life and each of his successors in title having, under the settlement, a limited estate or interest only in the settled land, shall during such period, if any, as the Land Commissioners by certificate in any case prescribe, maintain and repair, at his own expense, every improvement executed under the foregoing provisions of this Act. . . .

"(2) The tenant for life or any of his successors as aforesaid shall not cut down or knowingly permit to be cut down, except in proper thinning, any trees planted as an improvement under the foregoing provisions of this Act. . . .

"Sect. (38)—(1) Where a tenant for life is impeachable for waste in respect of timber, and there is on the settled land timber ripe and fit for cutting, the tenant for life, on obtaining the consent of the trustee of the settlement or an order of the Court, may cut and sell that timber or any part thereof.

"(2) Three-fourth parts of the net proceeds of the sale shall be set aside as and be capital money arising under this Act, and the other fourth part shall go as rents and profits."

If a Waste Land Planting Fund were created by enactment (as already suggested above), it would surely be a very simple matter for the Land Commission to grant advances for planting at 3 per cent., upon mortgage of the lands, plus the plantations, and also to arrange for the amortisation of the debt and the release of the mortgage either (*a*) by means of annual payments extending over the next thirty, thirty-five, forty, forty-five, or fifty years, or else (*b*) by refund of the capital sum and of compound interest at 3 per cent. payable on the timber-crops being certified to be of marketable age or mature and ripe for felling and selling. Of course,

it would be a *sine quâ non* that such advances would only be made on working-plans or schemes for planting and future management duly approved by the Forestry branch of the Board of Agriculture, etc., and provision would have to be made for exercising reasonable supervision to ascertain that the objects of the advance were being properly realised; but these would be mere matters of detail in a well-managed department.

(2) *Valuation of Woodlands and Plantations for Estate and Succession Duties and for Local Rates.*—The valuations made in respect of woodlands and plantations under the Succession Duty Act, 1853, the Finance Act, 1894 (for estate duty), and the Rating Act, 1874, are so complex, so illogical, so variable, and sometimes so unjust in their incidence as to call urgently for simplification and amendment. These provisions in question are as follows:—

Succession Duty Act, 1853, sect. 23.—"Where timber, trees, or wood, not being coppice of underwood, shall be comprised in any succession, the successor shall be chargeable with duty upon his interest in the net moneys, after deducting all necessary outgoings for the year, which shall from time to time be received from any sales of such timber, trees, or wood, and shall account for and pay the same yearly; provided that no duty shall be payable on the net moneys received from the sale of timber, trees, or wood in any one year unless such net moneys shall exceed the sum of ten pounds; provided that if the successor shall be desirous of commuting the duty, and shall deliver to the Commissioners an estimate of the net moneys obtainable by him from the sale of such timber, trees, or wood as may, in a prudent course of management of the property, be felled by such successor during his life, the Commissioners, if satisfied with such estimate, shall accept the same and assess the duty accordingly."

To satisfy the above requirements, the custom in England has generally been to value all the timber and other wood, and to take 3 per cent. of this as a fair annual return under good management. This income is then treated as an annuity, and succession duty has to be paid upon it on a scale laid down in tables annexed to the Act. Thus, if the life-tenant were forty years of age on entering into succession, and the annual income from the woods were estimated at £500 a year, the annuity would be considered as having a capital value of £7437½ assessable to duty (and not as £500 ÷ 0·03 = £16,666).

Finance Act, 1894, sect. 7 (5).—"The principal value of any property shall be estimated to be the price at which, in the opinion of the Commissioners, such property would fetch if sold in the open market at the time of the death of the deceased. . . .

"(8) Subject to the provisions of this Act, the value of any property for the purpose of estate duty shall be ascertained by the Commissioners in such manner and by such means as they think fit. . . ."

In Scots law, under the Valuation of Lands Act, 1854, sect. 6, in estimating the yearly value of lands and heritages, the same shall be taken to be the rent at which, one year with another, they might in their actual state be reasonably expected to let from year to year. Where they consist of woods, copse, or underwood, the yearly value shall be taken to be the rent at which they might in their natural state be reasonably expected to let from year to year as pasture or grazing lands (Bell's *Dictionary and Digest of the Law of Scotland*, 1890, p. 1106).

Rating Act, 1874, sect. 4.—"The gross and rateable value of any land used as a plantation, or a wood, or for the growth of saleable underwood, shall be estimated as follows:—

"(*a*) If the land is used only for a plantation or a wood, the value shall be estimated as if the land instead of being a plantation or a wood were let and occupied in its natural and unimproved state.

"(*b*) If the land is used for the growth of saleable underwood, the value shall be estimated as if the land be let for that purpose.

"(*c*) If the land is used both for a plantation or a wood and for the growth of saleable underwood, the value shall be estimated either as if the land were used for a plantation or a wood, or as if the land were used only for the growth of the saleable underwood growing thereon, as the Assessment Committee may determine."

Now, considering the desirability there is of encouraging the planting of poor land and the prudent management (for the national welfare) of timber-crops, which take long to mature, which are exposed to many dangers from storms, insects, fungous diseases, fires, etc., and which offer many a temptation to heavy thinning and premature clearance in the interests of life-tenants of estates, it seems very desirable that a short Act should be passed providing that in all cases in which plantations, woods, or coppices are managed in accordance with the provisions of a working-plan approved by the Board of Agriculture, etc., their assessment to rates shall be simply the rental value of the land in its natural and unimproved condition, and their valuation for succession duty and estate duty shall simply be such same rental value capitalised at twenty-five years' purchase (4 per cent.). Of course this merely assesses and values the land, and not the timber growing on it; but this is a very slight concession for the Treasury to make in view of the national duty of encouraging the home-growth of timber to the largest possible extent. And further, with regard to payment of rates, the option might be given of either paying them annually or else permitting them to accumulate at compound interest at 3 per

cent. till the plantations or woods are certified to be mature or marketable.

(3) *Risk of damage by rabbits* is a very serious matter as regards young plantations and the natural regeneration of mature timber-crops,—so much so, in fact, as to often imperil the chance of plantations proving profitable. No one can possibly assess the total amount of loss annually occasioned by rabbits to agricultural crops, grass lands, young plantations, and coppices throughout the United Kingdom; but I venture to assert that it runs not merely into hundreds of thousands of pounds, but may possibly far exceed one million pounds sterling.

In the conditions attached to gun-licenses it is expressly said that rabbits are not included among vermin; whereas it ought to be specified that rabbits are vermin, except in warrens expressly formed for their preservation, and properly enclosed with rabbit-proof wire-fencing to prevent their exit.

If national encouragement is to be given to extensive planting, the rabbit question is really a very serious one.[1] Except in properly enclosed warrens, everyone should have the right to kill and take rabbits; there should no longer be private property in rabbits (outside of warrens); and the warren-owner and his tenant-occupier should conjointly be liable to be proceeded against in the County Court for any damage done to fields, pastures, woods or plantations by rabbits which have escaped out of any such wire-fenced warren.

(4) *Higher railway charges* are made for the transport of home-grown timber than for the through booking of foreign timber. Where only comparatively small quantities of timber are in question, it is quite reasonable that there should be some difference; but it should not be difficult to arrange (by legislation, if necessary) that large quantities of timber (above a certain minimum) shall be conveyed at the same rate as is charged for foreign timber of a similar character. These preferential through charges on imported timber, and the system of measurement used by the railway companies, handicap home-grown timber heavily; and all the loss in its local value must ultimately fall on the landowner, because the prices paid by wood-merchants are based on what the timber will cost them delivered at the mill-yard or other destination.

[1] See also *Transactions* for 1906, Vol. XIX. Part I., page 104.

(5) *The risk of fire caused by sparks from railway engines* is a serious matter on dry land planted with pines and firs, which has been partly provided for in the Railway Fires Act, 1905, that comes into force on January 1, 1908.[1] But the claim for damage is, by sect. 1 (3), limited to £100 in the case of any action for damage, and this seems inadequate, while the provisions made for the prevention of fire might easily be rendered much more effective by some such additional section as the following:—

For the purpose of preventing or diminishing the risk of fire in a plantation, wood, orchard, or nursery, the owner may submit to the Board of Agriculture a proposal for the fire-protection of the same by means of reasonably necessary precautions, together with an estimate of the cost thereof, and on this being approved and sanctioned the Board may pass orders for the payment by the railway company, on the completion of the work, of a reasonable share of the actual cost, not exceeding a maximun of one-half of the estimate sanctioned or of one-half of the actual expenditure incurred, whichever may be the less in amount.

5. *How should Waste Land be Planted for Profit?*—Certainly, in as large and compact blocks as may be possible, because timber-crops grow better in large masses than in small woods; there is better shelter from wind, and a smaller proportion of wind-swept fringe; the circulation of soil-moisture is more equable; there is economy in the first cost of outer boundaries (if required) and fencing, and annually in supervision, for one forester can far more easily supervise four or five compact blocks, aggregating 2000 to 3000 acres, than he can exercise proper supervision over half of that acreage if scattered about in smaller blocks of 100 or 150 acres. And, of course, those tracts should first be dealt with which are within fairly easy reach of places likely to prove good centres for the future sale of wood.

Considering the present condition and the future prospects of the timber-market, there can be very little doubt that in plantations made for profit the main crops will be formed for the most part of coniferous trees. Our soil and climate are well suited for their growth; they can be grown on poorer land, and attain marketable dimensions sooner than hardwood-crops, which means that they can be grown without locking up so much capital in timber; they have a readier sale

[1] See also *Transactions* for 1906, Vol. XIX. Part I., page 73.

(especially as small stuff for pit-wood), and are, on the whole, more profitable than the hardwoods or softwoods grown on poorer classes of land. Indeed, conifers are often the only kinds of trees that could thrive on much of our poor land, and they are the kind of wood we are most in want of, as nearly nine-tenths of our timber-imports are of this description.

So far as regards the chief kinds of coniferous trees likely to prove profitable, one can merely generalise by saying that on dry, sandy land, Scots pine; on better, well-drained, loamier land, Weymouth pine, Douglas fir, and silver fir; on moister land, spruce; and on decidedly limy soil, Weymouth pine and Austrian pine will often likely be most suitable for forming the main crop; that timber-crops are usually best when formed of mixtures of different trees grown in patches; that a sprinkling of larch generally proves profitable on all land having good natural drainage; and that on the better classes of soil an admixture of hardwoods and softwoods is often also desirable. On suitable soil and situation, the largest and often by far the most profitable crops are produced by Weymouth pine, Douglas fir, larch, white willow, and black poplars.

The bulk of the waste lands suitable for planting consists of poor, deteriorated, rough mountain pasture and moorland peat-bogs, and the former are usually the more favourable for operations. Except to the comparatively small extent to which the peat-bogs have been cut away, there is not (even with previous drainage) much chance of planting with profit on land of this class; because, even with expensive drainage and ditching deep enough to break through the stiff layer of clay or the thin impervious moorpan, upon the presence of which the swampy moorland condition depends, timber-crops (even of Scots pine) do not thrive unless their roots can soon get into direct contact with the mineral soil. Hence this class of land, usually far from any favourable market for thinnings and mature timber, is not that deserving the first attention. Land overgrown with furze or broom should produce good timber-crops of mixed conifers, for it is usually loamy and naturally well-drained. Bracken-covered wastes are poorer in quality, while heather-grown land is often either very dry or very moist, and is generally so poor and deteriorated as to be better suited for pine than for more exacting kinds of trees.

The better class of waste land is covered with furze or broom,

or with a mixture of furze and bracken, while the poorer stretches of barren mountain-land and the shallow-soiled exposed uplands are generally overgrown with heather (ling) chiefly. The growth of grass is there never strong enough to interfere with planting. In the peat-bogs and their immediate vicinity, bell-heather and the common ling usually overgrow the surface-soil, and it is only the "cut-away" parts of such tracts that can be planted at present with any fair chance of profit. But these are, at the same time, just the parts that can easily be brought under profitable agricultural occupation.

Wherever large blocks of waste land are to be planted, either by the State or by private landowners, the work should not be taken in hand until a simple, clear, and definite working-plan for drainage, shelter-belts, and planting has been well considered and adopted for the next ten, fifteen, or twenty years or more, because the most essential conditions for success are (1) careful, methodical, economical, and far-seeing management, (2) natural or artificial shelter from strong winds, and (3) satisfactory natural or artificial drainage. Such a working-plan can be modified at any time if circumstances make amendment desirable; but there ought from the very beginning to be systematic method and regularity. It is not sufficient merely to arrange for planting the kinds of trees likely to thrive on the given soil and situation; one must also look ahead to the time when these plantations will become mature, and must consider how the timber can then be cleared without running needless risk of damage from wind and from insects. This looking far ahead seems usually to have been hitherto quite neglected when making large plantations in Great Britain and Ireland.

On open and wind-swept lands, large compact areas will seldom be plantable with profit without artificial shelter of some sort being provided to a greater or less extent by planting shelter-belts in advance; and on extensive stretches of hill-slopes, wind-breaks of this sort are an absolute necessity to give young plantations any fair chance of thriving.

When it has been decided to plant any extensive area of waste land, its boundaries will have to be fenced and a network of main and subsidiary roads projected and marked off in the manner most convenient for the future transport of thinnings and timber—though there is no necessity for metalling the roads

in the meantime—and this can easily be done from the contour-lines on the Ordnance Survey maps.

The road-system should be so planned that the whole area can be divided into main sections of about 440 yards square (40 acres), subdivided, if convenient, by narrower roads (220 yards apart) into 10-acre compartments, and having one side at right angles to the most dangerous prevailing wind (generally the S.W.). Shelters-belts should then be formed about 20 to 30 yards wide along the windward edge of each main section, if the planting of the whole area is intended to be accomplished within say ten years,—or along the windward edge of each alternate section, if it be desired to extend the planting over about twenty years,—and the intervening stretch can be marked off as the areas to be successively planted during each of the next ten or twenty years. The planting of such shelter-belts with quick-growing thickly-foliaged pines and firs should precede the planting of the rest of the area by at least five years, so as to allow the belts to establish themselves and thus become able to afford substantial protection against cutting winds to the younger strips of plantation successively formed year by year to the leeward of them.

Moorland peat-bogs are generally water-logged and rest on an impervious clay subsoil. Such cold land only produces stunted pine, birch, aspen, willow, and alder, in its unreclaimed state, or merely bears an unproductive soil-covering of heath, heather, and rough grasses and bog-plants. Even after drainage it usually remains dull and inert at first, though it often forms good woodland soil on becoming more earthy. Thorough drainage of such land by deep open trenches is necessary before planting can have any chance of succeeding, and after the drains are opened the land should lie fallow from twelve to eighteen months.

Unless drainage can be done cheaply and the mineral soil can be soon reached, there is small chance of peat-bogs being plantable with profit, as even well-drained hags of dripping peat will only grow Scots pine intermixed with birch, aspen, and also spruce in sheltered parts. On the better classes of bog and peat land white willow and common and Canadian black poplars sometimes do well, and may then prove the most profitable trees that can there be grown. Sometimes oak and ash can thrive on well-drained mossy soil resting

upon clay; but such land is usually only suitable for conifers and softwoods.

On hill-sides from 500 to 1000 feet in elevation planting may sometimes be more profitable than arable cultivation or pasturage. Their soil is mostly light, fairly good, and well suited for larch, Douglas fir, and Weymouth pine, the quickest growing and most profitable conifers, as also for other pines, spruce, and silver fir, while at lower positions the soil is often good enough both for hardwoods and softwoods.

6. *What will be the Probable Cost of Planting Waste Land, and what are the Prospective Returns from the Thinnings and the Mature Timber-Crops?*—Planting now costs much more than it used to. From 30s. to 40s. per acre, it has now, in many cases, risen to from £4 to £6, and even £6 to £8 per acre. Plants and labour now cost about twice as much as formerly; and rabbits are also so universal and destructive that the necessary wire-netting against this pest may add considerably to the cost of planting, and may in many cases swallow up any profit otherwise obtainable from growing timber. Conifers are usually cheaper to plant than broad-leaved trees. If the land is light, and requires little or no draining or special clearing, the cost of notching at 3 ft. by 3 ft. (4840 per acre), *i.e.*, the cost of plants and planting only, exclusive of draining, clearing weeds, fencing, rabbit-wiring, or filling blanks, would be about £3 per acre; and this may be taken as about the minimum cost at which it is now possible to plant, if the plants have to be purchased from a nursery.

But it will seldom be found possible to plant at anything like so cheap a rate. The land will probably often need drainage, clearance of heather and furze, trenching, or other soil-preparation, which all mean additional cost; and a stronger and dearer class of plant, with a more expensive method of planting, will usually also be necessary. Taking the general average of unimproved waste land suitable for planting, an estimate of £6 to £7 per acre (including beating up blanks for first two years, but not including rabbit-wiring) is not likely to be far wrong for the planting of conifers, mostly of Scots pine, spruce, larch, Douglas fir, Weymouth pine, and silver fir in mixed woods, planted in patches, and will also cover the cost of planting hardwoods and softwoods on good land requiring less drainage, but more clearing and soil-preparation.

If a great national scheme of planting were to be adopted, the planting of $3\frac{1}{3}$ million acres of waste land (see above, under 1) would probably cost about £6 an acre, exclusive of the cost of acquiring the land and maintaining the woods and plantations. This would mean a total actual outlay of about £20,000,000 (leaving compound interest out of consideration here), which could be spread over the next twenty, thirty, forty, or fifty years.

Considering the long period of time elapsing between the sowing and the reaping of timber-crops, and also the destructive gales that occur every few years, there must always be an element of uncertainty as to the future profit from planting, though actual experience has shown that land unprofitable for arable cultivation or pasture has often yielded good returns under timber. On the other hand, it is a well-known fact that the world's demands for timber are growing annually, while the area of possible production is diminishing yearly, and there is therefore a self-evident probability that timber may have a greatly increased value; but beyond this it is not very safe to go, and it is impossible to make trustworthy actuarial calculations either about thinnings or mature timber. In many of the least-populated parts of the United Kingdom, distant from seaports and railway-lines, there is so little demand for such timber as there is that mature crops are at present unsaleable,[1] and it would necessarily be a somewhat risky step to take if large plantations were made simply in the hope that conditions would improve by the time the timber-crops were mature. Near coal-mines there is always a demand for pit-wood; but, apart from

[1] Although our building and mining operations, railways, and many other industries require vast quantities of timber annually, yet there are many parts of the United Kingdom (more particularly in Ireland, the least industrial part of the kingdom) where there are practically no local industries requiring wood as their raw material. For example, most of the larch produced in the south-east of Ireland is shipped to Liverpool or Cardiff for pit-wood, and as its value is regulated solely by the price obtainable at these ports in competition with foreign imports, it often happens that the landowner only gets about 6d. a cubic foot for larch that could easily be disposed of at 1s. a cubic foot (and often more) in many parts of England and Scotland. For Scots pine and spruce grown along with the larch in Ireland there is often practically no market at all, not even as fuel; and the same may be said about small thinnings below pit-wood size. Without local industries consuming wood, the value of timber *in situ* therefore usually declines proportionately with the distance and the cost of transport from some assured market.

places within easy communication of these, any great increase in the present woodland area throughout the United Kingdom must, to be profitable, go hand in hand with the encouragement and improvement of existing wood-consuming industries, and the creation and fostering of new ones, before it is possible that any large investment of national capital in this direction is likely to have any fair chance of assuring direct monetary profit. Demand creates supply; but supply does not always create demand, and this is particularly the case with timber. A great impetus would at once be given in this direction if the proposed fiscal changes now under consideration should ultimately again include an import-duty on all sawn or partially converted timber imported from any *foreign* country in any other shape than round logs or rough-hewn squares. Such a change would at once give a great impetus to the saw-mill business, and would encourage the growing of wood for profit in a way that has never been done since the import-duty was entirely taken off imported timber in 1866. This, together with facilities for obtaining the loan of the necessary capital on easy but fair terms, would be more likely than anything else to stimulate planting on a large scale; and it would mean an immense addition to the amount spent in the transport and milling of timber, in the preparation of cellulose and wood-pulp, and in the creation and fostering of industries dependent on wood as their raw material.

A splendid example of extensive and successful planting on poor waste land is to be found in the conifer plantations made by Earl Fitzwilliam near Rathdrum, Co. Wicklow, during the famine years 1847-49, to provide work for some of the starving peasantry. The land was poor, and only of nominal value for grazing; but the timber-crops, now mature, are worth *in situ* from £50 to over £60 an acre (part was actually sold in 1903 at £63 an acre), while they have at different times given very fair returns from thinnings. The entire removal of timber-duties, in 1866, of course struck a hard blow at this desirable sort of enterprise, and no compensating inducements have yet been offered by Government to encourage landowners to plant.

7. *What would be the National-Economic Effect of Planting Waste Lands extensively?*—This has partially been indicated in the last paragraph above, but the following comparison of

the British timber-imports in 1882 and 1902 can speak for themselves:—

Wood and Timber—	1882.	1902.
Hewn, ...	£5,200,000	£5,400,000
Sawn, ...	10,800,000	17,100,000
Manufactured, . . .	300,000	1,400,000
	£16,300,000	£23,900,000
Paper (mostly made of wood-pulp),	£1,200,000	£4,500,000
Paper materials (mostly wood-pulp),	2,000,000	3,300,000
	£3,200,000	£7,800,000
Total, . .	£19,500,000	£31,700,000

Now, as our population was 35,241,000 in 1881, and 41,976,000 in 1901, it therefore follows that the imports of timber in the rough have fallen (proportionately to the population), and that the only increase has been in converted timber; and anything that will conduce to furnishing home-grown supplies of timber must also necessarily provide employment in various forms for our own workpeople, and must cause money to be circulated among our own industries in place of being paid to the other countries supplying us with timber. A great national movement in the direction of planting waste lands would therefore tend to gradually provide employment for certain sections of the working classes; but to what extent this would be the case it is impossible to say. It is estimated that the German forests (34¾ million acres) now yield about £22,000,000 a year, of which about £8,000,000 are spent on maintenance and extraction, leaving a net income of about £14,000,000, or over 8s. an acre. And as far back as 1875 it was also estimated that, in addition to all expenditure within the forest limits, the timber, etc., afforded employment to 9 per cent. of all the industrial classes, representing nearly one-sixteenth of the total population. Such facts as these may well lead thinking people to ask themselves if steps ought not to be taken to secure somewhat similar benefits for our own working-classes and for the country in general; and if so, I do not think the proposals made above (under query 4) can be called unreasonable.

* * * * *

State-planting or State-aided planting would help to provide employment in rural districts in autumn and spring, though

it is hardly likely in this way to contribute much towards the solution of the problem of the unemployed; but it would always be at least a step in the right direction.

There can, however, certainly be no question about the national benefits that would be derivable from large woodlands with regard to the maintenance, equalisation, and purification of our domestic water-supplies. And the activity now shown in different parts of the country in planting the water-catchment areas (*e.g.*, the Corporation works at Vyrnwy, near Liverpool, and at Talla Water, near Edinburgh) gives hope that perhaps some day soon the nation may awaken to a true knowledge of the importance of home-grown timber-supplies to the industrial wealth of a nation, and may then force the Government of the day, *nolens volens*, either to undertake State-planting, or else to give adequate assistance and encouragement to private parties—or to do both of these, which would be far preferable, and would all the sooner ensure the attainment of the objects desired.

XXV. *On the Advantages of Growing Pit-wood Timber.*

By W. MAITLAND STEWART, Edinburgh.

From the highest authorities we are assured that ere long there will be a shortage in the world's available supply of timber, and prices will advance in consequence. To meet this coming shortage, a lively interest is being taken in this country, with a view to promoting the growing of trees on those commercial lines which have already been adopted in Germany, France, and other countries with such excellent results financially.

An early training in forestry, and a somewhat long experience in the management of estates and woods, have afforded me ample opportunity of noting the growth of various classes of trees on different soils and in different situations, and also of seeing the results, good or bad, the failures, and the causes of failure. Actual experiences have a value which should be communicated to others, in the hope of aiding in the good cause of furthering afforestation on improved methods in this country.

In spite of the success gained abroad, and the almost absolute certainty that the same success could be achieved here if forestry were carried out on similar lines, the owners of the land are not too eager to lay out further large sums of money in planting. Some are unable to do so, others are reluctant to lay out capital with no return to speak of for sixty or seventy years, others remember the disasters of the past, viz., the larch disease, the results of storms, the increasing competition and loss of markets. They notice large well-grown forests unable to make a fair return owing to in-accessibility to markets. They are aware that prophets and enthusiasts have arisen in the past, as in the present, and that the older prophets have been proved somewhat wrong in their methods of planting as judged by results, and, in consequence of this, they are naturally slow to believe in the prophets of the present day. Personally, I should have absolute faith in planting on commercial lines; but this is only an opinion, and, though based on long experience, is not necessarily convincing. The blow-downs, the larch disease, the want of markets, and the faulty planting and thinning could all be avoided, or obviated

to a very great extent. But all the same, I can well understand that there may be many who have not had an opportunity to study the question themselves, and who hesitate to take the initiative; and it is to those that I would especially address my remarks as to the advantages of growing pit-wood.

A quick return for capital laid out in planting is a great consideration to those who have not the incentive to plant for the good of future generations, and pit-wood supplies this. A return of capital, as well as large profits, can be got in from twenty to forty years. In this class of forestry there is a most certain market. The demand for pit-wood is enormous. In 1905, 236,111,150 tons of coal were obtained in this country. The pit-wood required in connection with this output, at a common estimate of 6d. per ton, equals £6,000,000. In the county of Fife alone, pit-wood to the value of about £60,000 per annum is imported from abroad, and these vast coal-fields are only in their infancy. The requirements in pit-wood will be enormously increased in the near future, and inquiries have shown that exhaustion of the coal-fields need not be feared for many generations. The poor, low-rented lands generally found on the Coal-Measures are eminently suited for the growing of pit-wood. This I can answer for from my own observations, and I may instance the woods at Raith in Fife for the assurance of those who wish to see for themselves. Planting on the coal-fields, and close to the pits, does away to a great extent with the heavy cost of cartage and railway carriage, so disastrous to the profitable growing of timber in many parts of the country. Railways run through the coal-fields, and no plantation need be more than a few miles from a station or siding. Railway rates are by no means prohibitive where the distances are moderate, and there is only one railway company to deal with. I am indebted to the goods manager of the North British Railway Company for the following rates:—

1s.	10d.	per	ton	for	2	tons and upwards for	11	miles.
6s.	4d.	,,	,,		4	,, ,,	50	,,
10s.	5d.	,,	,,		4	,, ,,	100	,,

Another most important advantage in growing pit-wood is the comparative immunity from damage by gales. The crop, planted closely and in large areas, can be harvested before

coming to any great height, and is, therefore, practically free from danger.

I lately made a measurement of a young plantation of Scots pine, only twenty years of age, showing 2000 poles of 20 feet in height and 3 inches in diameter at the small end, which would have provided 40,000 lineal feet of pit-props. This, at 4s. 6d. per 100 feet (the present price of Swedish props delivered), would equal the handsome sum of £90 per acre, exclusive of several thousands of sheep stakes. I estimated that the outlay and cost of producing this crop amounted to £35 per acre, which included cost of planting and fencing, beating up, cutting, snedding, and carting to the pits close at hand, also a rental of 10s. per annum, rates, and compound interest at 4 per cent., made up from year to year on the original outlay, expenses, rent, etc., incurred from year to year. I do not consider that this plantation showed any exceptional growth, and am well aware that a very much larger return might be expected from Scots pine or spruce in a more advantageous soil and situation.

Larch also, on a suitable situation, might well be risked for its quick growth and much higher value. I have often seen larch do well on a dry, gritty, well-drained north bank; and in spite of the more or less universal disease, I think that it is well worth growing in moderation for a quick crop, and on chosen situations.

It is true that on poor clay soils, or on high exposed situations, a smaller crop might be expected from Scots pine or spruce than the plantation I have instanced, but even in these cases the crop would prove a very profitable one, if the trees were planted in large areas to provide as much shelter as possible.

I do not wish to advocate the cutting of pit-wood at twenty years growth. A larger profit might well be expected by waiting for another ten or twenty years, and without undue risk from gales. I only want to demonstrate that a good return may be obtained in a short time, if so desired. There are many who would hesitate to cut young woods, believing that they will obtain a much larger profit by waiting; but it must not be lost sight of that not only does the risk of destruction by gales increase with time, but compound interest on the outlay, rent, etc., mounts up to a pretty big sum, and, in addition to this, further fencing will be necessary.

The colliery companies obtain excellent pit-props from abroad.

These are clean, smooth, even sized, and well grown, and orders can be supplied with promptitude and to any required number. It cannot therefore be expected that odd lots of pit-wood grown in this country will always command top prices. A large plantation should be arranged for, and added to year by year, to allow of a steady out-put. At the same time, an odd lot of well grown props will command a fair price.

At forty years such a plantation as I have instanced might show trees of 51 feet in height, and 3600 cubic feet per acre (which estimate is taken from the Raith Estate Management Scheme). This would supply sleepers, round bars, and other timber required by the collieries, and would be valued per cubic foot, and not by the foot-run, as instanced in the twenty-year-old plantation above mentioned, which only provided pit-props.

For the guidance of those proposing to plant for pit-wood, I would recommend that the most careful attention be given to the proposed situation. The trees already growing in the neighbourhood will generally give some indication of what can be done, although they are too often coarse, thick-butted, and top-heavy, owing to over-thinning and want of shelter, to show clearly what they might have been if properly grown. Almost any sort of soil will suit coniferous trees of one sort or another if the drainage, artificial or otherwise, is right, and the altitude, say under 1000 feet. Good access to the railway or to the pits direct must be provided for, for the nearer the plantation is to the market the less will be the cost of carriage.

A large area must, if possible, be laid out for planting to allow of a steady supply of props annually.

The different sorts of trees are better kept distinct. The soil varies, and what suits one class may not suit another.

Every rabbit should be killed, and arrangements should be made to keep the stock down. Not only is this necessary in order to avoid the great cost of netting, but, what is of far greater importance, to prevent damage to the trees when they have come to such a size that it is too late to beat up or fill in the blanks, producing in consequence coarsely-grown trees quite unfitted for props. The blanks also often lead to blow-downs.

In giving my estimate of the value of a twenty-year-old wood, I do not forget that it is an estimate which is quite open to criticism. The price of Swedish props, viz., 4s. 6d. per 100 feet, might not be given unless the quality of the home-grown article

were equally good. On the other hand, some plantations of twenty years growth will show a much greater height than 20 feet. Unfortunately I am unable to give the actual cost of growing say a thirty or thirty-five year-old plantation, and the results of sale to the pits. About twenty years ago, in Wales, I grew and sold for pit-wood with good profit, but the figures are not with me at present. But whether my estimate be open to criticism or not, it may possibly help to draw further attention to what will, in my opinion, prove to be one of the most profitable branches of forestry.

XXVI. *Protection of Young Spruce from Frost.*

By GEO. U. MACDONALD, Forester, Raith, Fifeshire.

Considering the frosty nature of the weather which we have experienced throughout the whole of the present spring (1906), and the amount of damage which it has caused to young conifers which have been planted either on an exposed situation or in damp hollows that are naturally predisposed to hoar-frosts, it has occurred to me that it might not be out of place if I briefly described, for the benefit of readers of the *Transactions*, two instances on this estate where the most satisfactory results have been obtained by preserving for a certain time after the young trees were planted a portion of the growth which had previously covered the ground. In both cases the natural covering was self-sown birch.

As is well known, the Norway spruce, commonly considered to be one of the hardiest of our conifers, is nevertheless very susceptible to damage by frost in the earlier stages of its growth. Whether in the nursery or in the forest, it is amongst the first of its kind to show signs of awakening life in early spring, and, provided the weather and other conditions are favourable, a comparatively good growth is often made by the second week in May. Hence the reason why late spring and early summer frosts have such a disastrous effect on the young plants of this species.

The injurious effects of frost are readily seen in the red and scorched-looking appearance of the young shoots, which they retain throughout the whole of the succeeding summer. A considerable time elapses before the plants have so far recovered as to show signs of returning life; and generally they are so weakened constitutionally that they become a ready prey to the spruce aphis, which gives such an unhealthy and distorted appearance to the young trees.

Having had experience of the injurious effects of frost on young spruce plantations in this as well as in several other districts; and having heard of experiments being carried out in certain parts of Germany with a view to prevent, or at any rate to lessen, the damage done by frost to this particular species; and, further, being convinced that such injury is more prevalent and more destructive before the plants have reached a given height, I resolved to begin experimenting in the first place on a plot of

eight acres which, as already stated, was partially covered with a growth of self-sown birch. The area referred to is the western portion of the Begg Moss, which is part of a considerable stretch of ground that is practically flat, is difficult to drain, and stands at an elevation of 300 feet above sea-level. The situation and local conditions are such as to make it one of the most "rimey" areas in the district, and therefore the most suitable for my experiment.

It was in the autumn of 1899 that operations were begun to prepare the ground for the reception of a pure crop of Norway spruce, which was planted in February and March of the following year. At that time the average age of the self-sown birch was about ten years. In certain parts it grew in dense thickets; in other places the distribution was more uneven; while elsewhere the ground was quite bare.

Wherever practicable, the method employed was to thin out the birch to a distance of from 6 to 8 feet apart, and afterwards to roughly strip up the stems with an ordinary hedge-bill, until the trees gave the appearance of possessing umbrella-shaped crowns. Where the natural crop was thin, only the heaviest and roughest of the trees were removed, the stems of those remaining being dressed up in the above manner. It was under these conditions, then, that in the spring of 1900 the present young spruce plantation was formed. The trees, which were two-year seedlings twice transplanted, were notched in at an average distance of 3 feet apart, or at the rate of 4840 to the imperial acre. No beating up of any description has been necessary, the whole of the young trees having practically *held* from the time that they were planted. The rate of growth from 1900 till now has been remarkable, but this description applies only to those parts where the birch covering was fairly evenly distributed. Under these conditions, the young trees at present show an average height of from 6 to 7 feet; they are in perfect health, and show no evidence whatever of having been damaged by frost. But where the ground was altogether bare at the time of planting, the difference in growth is very noticeable, the young trees being only half the height of those grown under the more favourable conditions; while there is ample evidence in these parts that successive annual frosts have very seriously interfered with the natural development of the young plants. Here the plants are short and stubby, the average

height not exceeding 3 feet, while the colour of the foliage is a dull yellowish-green instead of the natural dark green of the sheltered plants. In short, those trees which were planted underneath the uniform shade of the birch standards are at present 50 per cent. better than are those which were planted in the open.

What has been clearly demonstrated in this case is, in my opinion, so important that it is well worth bringing before the notice of all those who are in any way interested in the growing of spruce. Generally speaking, it may be laid down that in most places where the birch readily reproduces itself the soil will be found of such a nature as to justify the growing of spruce. In many outlying districts, ten or twelve years old birch is of no practical value, and in such instances it is customary for the forester to look upon it as nothing more than a weed which has to be cut down and burned before another crop can take its place. To all those who have to deal with areas of this description I would strongly recommend that as many of the natural birch standards be left on the ground as may for a time afford protection to the coniferous crop, more especially if this consists of Norway spruce.

A natural question to ask here is, how long should the birch standards be allowed to remain over the young crop? In the plantation under review, the whole of the birch were removed during the autumn of last year, or five years after the spruce trees were planted. This was done because, in the first place, it was considered that the young plants had overgrown the frost-zone, which I consider is most destructive at from 2 to 3 feet above the surface of the ground;[1] for once the spruce reaches a height of 4 feet and upwards, the injurious effects of frost are reduced to a minimum. Secondly, they were removed because of their tendency to overdraw the young trees; and in the third place, it was considered desirable to remove them while they were light enough to allow of their being carried out of the plantation on men's shoulders, as otherwise a considerable amount of harm would have been done to the spruce if the use of horses had been necessary for the dragging out of the birch. Yet another, and not less important, reason for their removal at

[1] The actual depth of the frost-zone at any point will, of course, depend on the configuration of the ground.—HON. ED.

this stage may be given. The trees had arrived at a size at which they could easily be disposed of as crate-wood, which in this particular locality is worth 20s. per ton on the ground. This sum not only repays the cost of trimming up the stems and the ultimate removal of the birch, but it goes a good way in reducing the initial cost of the young plantation, and were this method more commonly practised, it could not fail to prove remunerative.

The second instance in which a similar experiment has been tried is in the block known as the Torbain Moss. The soil here is of a peaty nature, is difficult to drain, and, as a natural consequence, it is very liable to hoar-frosts. Its elevation above sea-level is practically the same as the Begg Moss, namely, 300 feet.

Many parts of this area, which is over 50 acres in extent, and which in the open carries a rough crop of heather, were found very difficult to restock, especially with spruce. In some instances several attempts had been made with very unsatisfactory results. Other causes, such as damage by pine-weevil and ground game, added to the difficulty of restocking; but by far the greatest drawback to successful planting were the late spring and early summer frosts. At the south-western corner of this block, an area of about 5 acres was covered with a fairly dense crop of self-sown birch. Having by this time noted the satisfactory result of the Begg Moss experiment, it was decided to treat this portion on exactly similar lines. This was done during the spring of 1902, when the birch—which was from 7 to 10 years growth—were thinned, and the young spruce were introduced underneath their shelter. The standards still remain, while the growth of the spruce is all that could be wished for.

[Where naturally sown birch is not found on the ground, a light crop of that sylviculturally useful species might be raised by means of broad-cast sowing. This would cost but little, and after a few years would provide the shelter needed by young spruce.—HON. ED.]

XXVII. *Profitable Co-operative Timber-Growing.*

By ROBERT GALLOWAY, S.S.C., Edinburgh.

SUGGESTERS OF CO-OPERATION IN FORESTRY.

The idea of co-operation in timber-growing is not new, but in recent times its chief advocates have been Professor Somerville, Professor Schwappach, Dr Schlich, Sir Dietrich Brandis, Mr Gamble, Mr Massie, and various essayists who have written for the Royal Scottish Arboricultural Society. Dr Somerville and others advocated the establishment of a limited liability company. Mr Massie suggested that the company should also establish a Forest School in connection with the forest. Dr Schlich and Sir Dietrich Brandis dealt with communal or corporation forests; and Mr Gamble referred to Continental Forestry Societies which owned and worked forests of their own. In concluding his remarks, he said: "In the United Kingdom also it may one day be possible for some of those whose means allow them to be content with but a small dividend for a few years at the beginning to invest money in forest companies and acquire properties which, under good management, would soon become not merely a provision against dearth of timber in the future, but a good investment."

It might also be mentioned that there are public companies in several countries on the Continent of Europe, in the United States of America, and in several of the British colonies, which own and manage forests.

OBJECTS AIMED AT.

Dr Somerville's objects were the provision of a standing model in modern sylviculture, a training ground for foresters, and an opportunity to all interested in Forestry to become partners in such a concern. He thought also that the venture would prove a good investment, although the return might be delayed. Professor Schwappach thought that, apart from State Forestry, co-operation was the only method by which successful afforestation could be carried on in this country. One of the essayists referred to advocated his views on the ground of affording help to small proprietors in economising expenses, securing uniform prices,

utilising machinery, accelerating the execution of orders, and utilising softwood by conversion into wood-pulp.

Capital required.

The capital required would, of course, depend upon the extent of the operations engaged in. Professor Somerville thought that the company advocated by him could be carried on successfully with a capital of £7000, which would enable 500 acres to be bought and planted. He proposed that the shares should be £1 each, so that all might have an opportunity of participating in the undertaking. In the Society's scheme for the establishment of Model Forests, the sum aimed at was £40,000, to be devoted to the purchase of 1500 to 2000 acres of land, with about 500 acres of growing woods, averaging forty years of age.

None of the other authorities go into the outlay required; but Dr Schlich has made elaborate calculations to show at what price land might be acquired for afforestation purposes and be expected to yield at least 2½ per cent. on the venture. His figures are—Oak, £9, 11s.; beech, £9, 17s.; Scots pine, £14, 5s.; spruce, £15, 1s.; silver fir, £16, 6s.; ash, £24; larch, £34, 2s. If the land could be got at a cheaper rate, the interest would be higher, and *vice versâ*.

Room for Expansion.

On the subject of waste land suitable for afforestation, accurate figures, of course, cannot be given until a proper survey has been made; but all the authorities are agreed that there are several million acres of land which are now practically lying waste, or are yielding a very small rental as grazing land. The Departmental Committee in their Report say: "As regards the question of the extension of the forest area, it is shown on the highest authority that there is in these islands a very large area of waste, heather, and rough pasture or land out of cultivation, amounting in all to 21 million acres, on a large proportion of which afforestation could be profitably undertaken."

Of the total of Great Britain and Ireland, only 4 per cent. is under forests, as compared with 17, 18, and 26 per cent. of Belgium, France, and Germany respectively. It is therefore apparent that, as compared with these continental countries, which

are not overwooded, there is plenty of room for expansion of our forest area. Dr Nisbet points out that although our present woodlands were trebled in extent and fully stocked, they would only supply our present needs, while 3 millions of acres might be needed for future expansion. Mr Munro Ferguson said, in the House of Commons, that our home production was small, but that the area available for growing timber was enormous, and referred to the large population which might be employed in forestry and in kindred and incidental industries.

Suitability of Soil and Climate.

The authorities are unanimous that the soil and climate of Great Britain are eminently suitable for the growth of timber. The Departmental Committee in their Report say: "It is the common verdict that timber of the kind and quality imported in such large quantities from the Baltic and similar temperate regions can be grown as well here as anywhere. . . . That foreign is so generally preferred to home-grown timber is in no way due to unsuitability of soil or climate." One point with regard to soil, to which Dr Schlich draws attention, might with advantage be referred to. He says: "Where land has been lying waste for some time it has suffered deterioration and cannot be expected to yield at once a full return, but after the forest crop has been established the producing power will increase. The loss of increment in the beginning is the penalty we shall have to pay for neglect in the past."

Imports of Timber.

The total value of the imports of unmanufactured wood and timber during the past three years, in round figures, is:—

In 1903, ...	£27,000,000
„ 1904, ...	23,500,000
„ 1905, ...	22,750,000

The manufactured imports during these years were valued as follows:—

In 1903, ...	£2,250,000
„ 1904, ...	2,000,000
„ 1905, ...	2,000,000

These figures show a small decrease, but in previous years there was a constant increase. Dr Schlich points out that whereas the population of the United Kingdom has during the last twenty years increased by about 20 per cent., the imports of timber have increased by about 45 per cent., thus showing that more timber is now used in proportion to the population than formerly.

Depletion of Foreign Forests.

The whole of the authorities are agreed that the most easily accessible foreign forests have been worked out, and that the supply of timber of first-rate quality is now very uncertain. Dr Schlich and M. Mélard go very carefully into these points, and both are agreed that Canada is the only country that can be looked to for a supply of coniferous timber; but they are of opinion that, as systematic management has not yet been introduced there, these forests may also prove insufficient for the demand which will be made upon them. M. Mélard says a timber famine is within sight. Dr Schlich says supplies from outside rest upon a very unsafe basis. His figures, published in 1904, show that the European countries, taken together, were importing 2,620,000 tons of timber per annum to meet their requirements, which were yearly increasing. It is now known that both Norway and Sweden cut annually much more than they grow, and that the position of Russia in this respect is at best doubtful.

The Departmental Committee in their Report say: "It will be found in our evidence that experts of high authority have recorded the opinion, already expressed in many reliable publications, that the world is rapidly approaching a shortage, if not actual dearth, in its supply of coniferous timber, which constitutes between 80 and 90 per cent. of the total British timber imports."

Rise in Price.

It follows, as a matter of course, that if the more accessible supplies are becoming exhausted, more distant forests will have to be drawn on, and the expense of realising these forests will be consequently greater. Dr Schlich says: "In my opinion we will never again see the low prices of ten to fifteen years ago,

because the more accessible forests in the exporting countries have been heavily worked, if not exhausted, so that the timber for exporting has, year by year, to be carried over longer distances before it reaches the sea. Prices in the future are likely to be higher than in the past."

Cost of Planting and Management.

The cost of planting will, of course, depend upon the subject to be dealt with. Dr Somerville estimated £3 per acre in connection with his scheme, and 4s. per acre for management during the first twenty-five years. Dr Schlich gives the following figures:—Spruce, £3, 10s.; Scots pine, £4; larch, £4, 10s.; beech and silver fir, £5; oak and ash, £6. Mr Macdonald, forester, Raith, quotes £5, 13s. 9d. for planting, enclosing, draining, and forming roads in the case of Scots pine, larch, and spruce, and £6, 15s. in the case of hardwoods. Management, etc., he estimates at 3s. per acre per annum. Dr Nisbet estimates £6 to £7 per acre, including beating up for two years. Mr A. C. Forbes states the figure as high as £8 per acre.

Revenue Expected.

As forest book-keeping has not been practised in this country, it is scarcely possible to obtain reliable data as to the profits of woodlands in the past. The revenue that may be expected will, of course, depend very largely upon the cost of the land, the initial outlay, and the cost of management. All the authorities are agreed that a return of at least 2½ per cent. can be assured on the expenditure involved; and in favourable circumstances it is confidently expected that a higher percentage may be looked for, although, of course, unless there should be an area of mature timber upon the ground, which could be gradually realised, the return would be deferred for a considerable number of years. The investment would therefore partake, as Dr Somerville points out, of the nature of a life insurance. All the authorities appear to agree that land which does not yield more than a rental of 7s. 6d. per acre can be profitably afforested.

The following statistics, prepared by Dr Schlich, as to the

estimated yield of British plantations on land of medium quality are of interest in this connection:—

Name of Tree.	Price per Cubic Foot of the Timber.	Most Profitable Rotation in Years.	Yield per Acre in Cubic Feet.	Cost of Planting per Acre.	Cost of an Acre when Wood is Mature, with Compound Interest 2½ per cent.	Value of Land per Acre which, when planted, pays 2½ per cent.
	s. *d.*			£ *s.* *d.*	£	£ *s.* *d.*
Oak, . . .	1 5	130	46	6 0 0	149	9 11 0
Beech, . .	0 11	120	57	5 0 0	97	9 17 0
Scots Pine, .	0 8	80	70	4 0 0	29	14 5 0
Spruce, . .	0 7	90	84	3 10 0	32	15 1 0
Silver fir, .	0 8	120	111	5 0 0	97	16 6 0
Ash, . . .	1 5	70	40	6 0 0	34	24 0 0
Larch, . .	0 11	70	73	4 10 0	25	34 2 0

These figures are given on the assumption that all forest operations are conducted in a truly economic manner. Dr Schlich further points out that if timber is grown on a short rotation for fencing or pit-props, the yield, according to the price of land, might be from 9 per cent. to slightly over 3 per cent. in the case of larch, and in the case of Scots pine and spruce, from over 5½ per cent. to 2½ per cent.; and he thinks that land capable of growing Scots pine and spruce is not likely to cost £9 an acre, probably not more than £4 to £6, and in that event the return might be from 4 per cent. to 5 per cent. Mr A. C. Forbes says the average net return per acre per annum from a properly selected area may be put at from 10s. to 15s., allowing for non-productive ground, and calculating on the basis of present prices for timber, labour, and material. If an average total return of £125 per acre can be obtained from land not worth more than 5s. per acre for agricultural purposes, no difficulty should be experienced in securing the average net annual yield of 10s. to 15s. per acre, which has been stated as possible from a well managed area. Mr Lewis Miller says that in his experience a return of £1 per acre should be obtained from land under timber which is only worth from 1s. to 2s. per acre for sheep or cattle pasture.

The Douglas fir plantation at Taymount, belonging to the Earl of Mansfield, might be quoted as a successful example of forestry, and if the value of that plantation would appear to be exceptional, it at any rate shows what is possible in favourable circumstances. From reports which have recently been published, it is said that during the fifteen years from 1888 to 1893, there has been an increment on this plantation amounting to 495 standard cubic feet per acre per annum, which is equivalent to about 370 feet by quarter-girth measurement, and which, at 9d. per cubic foot, represents a rental of £14 per acre per annum during these fifteen years.

Revenue from Foreign Forests.

While returns from foreign forests cannot be accepted as conclusive evidence that similar returns might be expected in this country, seeing the conditions as to labour, etc., are different, still the figures which are available are interesting. Dr Schlich says, with regard to Saxony, where complete records of past management are available, that while the growing stock on the ground and the annual output have both been increased, the net return, after deducting every item of possible expenditure, has increased gradually and steadily from 4s. for the period from 1817 to 1826, until, in the year 1900, the average return was 22s. 6d., which represents an increase of 463 per cent., one quarter of which only was accounted for by increase in the price of timber, and the remainder by improvement in management. The figures refer to Saxon forests as a whole. According to Dr Nisbet, the revenue from the French State Forests in 1904, as stated in his "Notes on Continental Forestry," was 5s. 10½d. per acre, but the charges debited against the maintenance of the State Forests included large sums expended in the purchase and replantation of waste lands, in the upkeep of certain forest schools, in improvements to water-courses, and in the maintenance and improvement of inland fisheries, so that the actual revenue was considerably larger. He gives the net revenue of the State Forests of Prussia in 1905 as over 7s. per acre, but adds that as many of the expenses are not strictly for maintenance and upkeep, etc., the actual amount which might be considered the net return is in reality considerably above this sum. Sir Dietrich Brandis says that ten ranges in Saxony yield over 40s. an acre, and that nine ranges in Baden yield 53s. per

acre. The forest revenue in Germany had grown in a remarkable manner, having, in some cases, trebled within twenty years.

Prices of Home and Foreign Timber compared.

Professor Schwappach, in his paper on the "Condition of Forestry in Britain in 1901," says: "The conditions for forestry in Britain are by no means unfavourable. The prices for timber are from twice to three times as high as in Germany."

Quality of Home-Grown Timber.

A good deal has been said as to the quality of the timber grown in this country. It is the universal opinion that our coniferous timber, when it is grown in open woods, as it usually is in this country, is of inferior quality; but where occasional patches have been found grown under similar conditions to those in Germany, the quality of the timber has been quite equal to anything got from abroad. Hardwoods grown in this country are for many purposes superior to anything imported. The universal opinion is, that with proper sylvicultural management, our home-grown timber would be at least as good as timber imported from abroad. The Departmental Committee in their Report say: "That foreign is so generally preferred to home-grown timber is in no way due to unsuitability of soil or climate, but is entirely due to our neglect of sylvicultural principles." The exhibits of timber at the annual exhibition of the Royal Scottish Arboricultural Society in the Highland Society's Show have made it clear that timber of the finest quality can be grown in Scotland. The specimens exhibited there are, of course, specially selected, but they show what the soil and climate of this country can produce.

Yield of Home Forests.

The Departmental Committee say: "That the yield of our woodlands can be materially improved admits of no doubt."

Substitutes for Timber.

Dr Schlich, in "Our Forestry Problem," referring to the efforts made to substitute iron and steel for timber, quotes from Mr Hawkshaw's presidential address to the Institute of Civil Engineers, as follows:—"Engineers could not do without timber, nor,

indeed, without much timber. For the last thirty years they had heard it said in that room that steel would shortly be adopted in place of wood for sleepers; but although we could make our own steel, but had to import our timber sleepers, this had not come to pass." Then Dr Schlich goes on to say: "The same experience has been gained in France and in the United States of America, the home of the great iron and steel trusts."

Wood Consuming Industries.

Most authorities agree that extension of our woodland area would also involve the establishment of industries for all kinds of forest produce, including small wood, the manufacture of pulp, etc. Mr Gamble says there is no reason why much of the private waste land in the United Kingdom should not be devoted to wood-pulp timber-growing, and there is every reason to think that it would be a profitable industry. Mr Lewis Miller said the demand for spruce for paper-making had been increasing very rapidly during the past few years, on which account the price of spruce had gone up very much, and in the future it was likely to be as valuable as larch. In a paper read before the Society of Arts on 19th May 1905, Mr S. Chas. Phillips, M.S.C.I., said: "I think it would be fair to estimate that each day one of our large London daily papers consumes 10 acres of an average forest." And Mr R. W. Sendall, on the same occasion, said the daily issue of a halfpenny paper, with a circulation of 200,000 copies, consumed no less than 200 trees in the preparation of wood-pulp. If these statements are correct, they show the enormous importance of this industry and the possibility of its development.

Conversion of Timber in or near the Forest.

Mr S. Margerison says: "A considerable amount of additional profit may be produced, especially where forestry is conducted on a large scale, by the partial conversion of the timber near to where it is grown, so as to reduce its bulky occupance of space in transport, and a consequent reduction of cost of carriage."

Transport.

On this point the same authority says: "As to transport, the advent of the petrol engine and the rapid evolution of the motor

car and motor waggon have changed the prospects and conditions of land carriage very materially. For medium loads we are no longer so dependent upon the railways, with their rates of carriage differentiating between native and foreign produce. The delays, inconveniences, and friction which have been consequent upon handling and transhipping timber from wood-waggon to railway trucks, and from the trucks to the wood-waggon again, can now, at any rate in the case of converted and semi-converted timber, be obviated. Loads of pit-props, deals, planks, etc., could be taken straight from the forest or forest saw-mill to the consumer's yard by motor waggons."

Woods and Game.

This point has been dealt with by several of the authorities. It is, of course, the general view that rabbits and woods cannot be maintained together, but it is quite possible to have plenty of game of other kinds in connection with well managed forests.

Artificial Manures.

The importance of artificial manures in forestry has only recently been recognised. Extensive experiments have been made in Belgium and Germany, and the results have shown that with a judicious use of artificial manures the timber growth can be wonderfully stimulated, in the early stages at least. As yet experiments have not been extended to older trees, but it has been clearly demonstrated that where the ground is too poor to develop young trees naturally, the application of artificial manures has yielded amazing results. These results have been tried both with natural regeneration and upon plantations which have been unsuccessful without artificial aid. Dr Borthwick brought this subject prominently before the members of the Royal Scottish Arboricultural Society at their annual meeting in February last.

Small Holdings.

Mr John Annand has expressed the view that any scheme of afforestation should be accompanied by the creation of small holdings. He points out that all estates have a certain proportion of arable land which is too valuable for afforestation purposes; and that on purchasing estates for afforestation such

arable land could be broken up into small holdings. In this way a constant supply of labour would be found for forest operations, and the occupants of the holdings would at the same time be able to earn considerable sums over and above what they could make out of their holdings. The great difficulty in connection with the creation of small holdings is, of course, provision of the necessary buildings; but in the event of the Government granting any facilities or assistance to proprietors to provide such buildings for small holdings, a company would share in such benefits.

Conclusion.

In view of what has been written above, the question to be determined is whether it is possible to form a limited company, for the purpose of purchasing and afforesting land, as a profitable undertaking. The answer depends upon the meaning of the word "profitable" in this connection. *If 2½ per cent. certain, with the possibility of a larger return*, combined with safety of capital, is considered satisfactory, then the undertaking can confidently be recommended to members of the public who happen to be specially interested in the subject of afforestation or of rural depopulation. A higher rate of interest than 2½ per cent. may be obtained, but cannot be relied upon. There is no doubt that for those who are already owners of waste land, or land of a low agricultural or grazing value, afforestation is the means of eventually increasing not only the annual return, but also the capital value of their land. Many estates comprise poor land which yields little more than a small rate of interest on the cost of the buildings, fences, etc., and such land should be afforested, not only because of the subsequent enhancement of the annual and capital values of that and of adjoining land, but also because of the increased employment which would be afforded. The question of death duties, however, is a serious drawback to private afforestation. In the case of companies or corporations there is no such difficulty. They are not affected by the death duties. Rating, however, affects all owners.

Is there a sufficient number of the landless public interested in afforestation and rural depopulation willing to become shareholders in an undertaking promoted with the object of acquiring and afforesting land on a small scale, knowing that the return,

though certain, must be deferred, and that their shares will increase in value with the increasing productiveness of the soil, as the result of years of sound sylvicultural management? It has been shown that such people have been found in Germany and other countries, why not in Scotland? "Surely," as Mr Massie said, "we have as many public spirited gentlemen in Scotland as would take up shares even if we could not promise them any great dividend." And Dr Somerville's words in this connection might also be quoted, "If we are sincere, as I believe we are, in advising landlords under certain circumstances to invest their thousands in tree-planting, we cannot refuse to contribute to a scheme which offers everyone the chance of supporting his opinion to any reasonable extent, from £1 upwards. If a feasible scheme was submitted to the country, and if it should happen that it is not heartily taken up, it will at all events have served one good purpose, in exposing the insincerity of those who advise others to do what they would not do themselves."

The great difficulty is in the beginning. When once the company is formed and the forest set agoing, with some revenue coming in, all other difficulties would vanish. It would then only be necessary to maintain that continuity of management, which is more easily secured by a limited company than a private proprietor.

Authorities Consulted.

In preparing the foregoing Memorandum, the writings and speeches of the following authorities have been consulted:—Dr Somerville, Dr Schlich, Colonel Bailey, Dr Nisbet, Mr J. S. Gamble, Professor Fisher, Professor A. C. Forbes, Dr Borthwick, Sir Dietrich Brandis, Professor Schwappach, M. Boppe, M. Mélard, Mr Munro Ferguson, M.P., Mr Stafford Howard, Mr W. H. Massie, nurseryman; Mr John Annand, estate overseer; Mr G. U. Macdonald, forester; and Messrs Lewis Miller, Adam Spiers, and S. Margerison, timber merchants; and also the Report of the recent Departmental Committee on Forestry issued in November 1902, which is the most authoritative pronouncement upon Forestry generally which has yet appeared in this country.

XXVIII. *Notes on a Visit to Switzerland and Germany*, 1905.

By JOHN J. R. MEIKLEJOHN, Novar, Evanton, Ross-shire.

I left England at 10.30 P.M. on the 6th of June, and travelled by rail on the following day from the Hook of Holland to Basel. Next day I went to Zurich, and thence to Sihlwald. When I arrived at Sihlwald, I found that Herr Ulrich Meister, Stadforstmeister, to whom I had an introduction from Dr Schlich, was attending a sitting of the Federal Assembly, of which he is a member, but I was kindly received by his assistant, Herr Conrad Tuchschmid, and three English students from Coopers Hill. These four gentlemen took much trouble to inform me about the forest, and I would take this opportunity of recording my thanks to them for their goodness.

I learned that the forest I had come to see is the property of the municipality of Zurich. It extends to 1153 hectares (2848 acres), and is chiefly situated in the valley of the Sihl. The Sihl is a small mountain stream, and the forest, which occupies the steep slopes on either side of it, extends for a length of 13 kilometres along its course.

The forest is a very ancient one, there being written records of its produce and management since the eighth century. The first known survey of the forest is dated 1680, and a copy of a survey dated 1743 is in the hands of the managers; both of these testify to the long time this forest has been under systematic, enlightened management. A good State road and a railway now run through the valley, and these give to the forest facilities of transport both by road and rail.

The produce of the forest is all manufactured on the spot, and in the afternoon I was taken over the works, which were near our hotel, in order to see the manufacturing processes carried on in the valley of the Sihl. The machinery is driven by water from the river, which is got in large volume, and one turbine of about a hundred horse-power drives the plant. There are several sawing machines, several dressing and planing machines, and three or four machines which make the material known as "wood-wool." This consists of narrow, thin shavings of wood made from thoroughly seasoned spruce, and it is used for packing fruit, etc. It fetches from 14s. to 35s. per

100 lbs., according to its fineness. There is a drying chamber in which the spruce used for making this material is dried artificially when the demand is so great that it cannot be met by wood dried in the open air. There is also in use here a system of impregnating wood with sulphate of copper. The sulphate is dissolved in water, and the solution is placed at a height of 30 feet above the logs to be operated upon. It is applied to the logs in the following way:—The log is placed on a frame, the butt end being somewhat higher than the thinner end. A flat board is placed over the butt of the log, after a piece of hempen rope (to prevent leakage) has been laid between it and the periphery of the log. The board is firmly fixed to the log by means of screw-headed dogs. The liquid is then introduced by means of a flexible tube into the space between the butt and the board, and the solution is carried into and through the log to its thinner end by the force of gravitation from the elevated reservoir. It will have found its way through within a period of from three to ten days. This is proved by applying potassium ferro-cyanide to the lower end of the log, which shows a reddish brown colour if sulphate of copper be present. The natural sap is replaced by the sulphate solution, and the wood is impregnated by the copper, whereby its durability is increased from seven to twenty-one years.

The beech is used for firewood, and there are several machines used for preparing it. It is cut in the forest into lengths of 2 to 3 feet, and the pieces are split and piled until they are dry. They are then brought into the mill and cut into 9-inch lengths, and these are again split by machinery into pieces 1 inch in thickness. They are then driven into hoops which contain about ½ cwt., and sold, and, when empty, the hoops are returned to the factory to be refilled. The larger beech is impregnated and sold for sleepers. The spruce is piled after it is impregnated, and is disposed of for telegraph and telephone poles. There were several machines for making handles for tools, agricultural implements, etc., from ash, and these handles, which are beautifully finished, are turned out with great speed.

On the 8th June I again examined the manufacturing processes, and I was also shown through the office and saw the system of book-keeping which is used at present by Herr Tuchschmid. It is the neatest and most exhaustive method I have ever seen.

In the afternoon we visited one of the municipal forests at Zurich. This forest had been used as a coppice-wood for many years, but it is now being changed into high-forest, under the direction of Herr Ulrich Meister. This inspection took us to the summit of the Abishorn, from which we had a magnificent view of the country. The city of Zurich in the foreground, with its beautiful lake, with many towns on its margins, all lit up by brilliant sunlight, and the snow-clad Alps in the background, formed a picture which I cherish and shall ever store in my mind.

On the 9th June I walked along different compartments of the forest, and saw those parts of it which are from 5 to 10 and 70 to 100 years old. The woods are all propagated by natural regeneration, and as soon as the crop is partially removed to admit light, the soil is almost immediately covered with a great variety of species—maple, sycamore, beech, ash, elm, spruce, silver fir, etc. In five years thereafter it is as thickly stocked as a good crop of oats, and then the tending operations begin. First of all labourers remove the small, thin trees, which are mostly suppressed, and they are followed by more skilful foresters who select the trees that they wish to remain on the ground; and this process is followed every five years for the first twenty or twenty-five years of the growth of the forest, by which time only the most select, straight, well-grown trees, with close even crowns, are left. Afterwards the thinning periods are seven years or more apart, and the thinnings are directed to further improve the final crop. It was interesting to observe how perfectly the work was done by the labourers in the first instance. They cut out the inferior growths, laying them all with their crowns in one direction, and the more skilful foresters who followed continued that regular process. After these thinnings had been cut and laid on the ground, a number of old men who were employed on piece work followed, and drew them on to the adjacent paths (which would have been a laborious process but for the way in which they were cut and laid down), cut them into lengths of from 28 to 30 inches, and bound them up tightly with wire by means of a ratchet attached to their packing-barrows. These bundles were then piled in stacks, and sledged or carted for firewood. The cost of cutting and bundling is 12 francs (9s. 6d.), and the value of the faggots in the wood is 45 francs (£1, 15s. 6d.) per hundred. In the afternoon we again walked up the

slope, but at a more northerly point, and saw the last year's fellings. The logs had been removed by tram-lines and a timber slide. Only the firewood remained, and this lay piled on the ground in bundles 3 ft. 3 ins. long by the same in circumference, and tied up by wire. The soil from which the cuttings had been made was already showing its prolific nature by the close crop of seedlings which was appearing, and we were told that planting never yields the same timber and growth as natural regeneration does. I visited the Scots pine plantation on the 10th June, and we were told that in this forest they always grow Scots pine mixed with silver fir, spruce, and beech. To show how few plants they raise in the nursery, we were shown a nursery of 20 square yards, and the forest to which it applies extends to 1000 hectares. Herr Ulrich Meister, who had returned from the seat of Government at Berne, impressed upon us that from the long history of the forest, and from his own experience, the safe and sure maxim in forestry which one should study was to grow the indigenous trees. The growing of these to perfection was certain in the end, he said, to produce better results than any imported ones would do, and, as an example, he gave us the case of the larch, which was introduced into these forests in 1797. Although a few good specimens of this tree are to be seen, they do not seed, they are unthrifty in appearance, and cannot be regenerated naturally, and Scots pine far outgrow them in height when they are seen together. He also confirmed the information I had already received, that woods naturally regenerated were far superior to those which were planted.

In these Scots pine woods the process of regeneration goes on in the same way as is described above in the case of the hardwoods. The trees are gradually removed, and the young growth quickly follows the operation, so that by the time the last mother-trees are removed the ground is stocked. The heavier pieces are cut into the most useful lengths, ready to be slid or rolled down later on, and they are dealt with at the mill as described in the opening paragraphs of this Report. The Scots pine is worth, when well grown, about 60 francs (£2, 7s. 6d.) per cubic metre (= 35 cubic feet). Higher up the slope I was shown a place which was originally a wide, sour, grass-grown bog. It was planted with spruce, and that crop grew on it until it was about 30 to 40 years old, when the trees

were found to be suffering from red-rot. These were cut, and since then the ground has covered itself naturally with a crop of a great many species of hardwoods, which could not be got to take root on it in its natural state, thus showing how soil may be improved by the growth of any kind of timber which can be got to grow upon it.

On the 12th of June I visited the spruce wood, where experiments in different degrees of thinning had been carried on for five years. It was divided into sections A, B, C, D. The least thinning was done in section A and the most in section D, and it was found, so far, that the greatest increase was obtained in section C, which was thinned in a medium way. In section D the suppressed and dominated and some dominating trees were taken out. Every five years the crop on these experimental areas is measured at the height of 4 ft. 3 ins., and is marked by red lines. All these measurements are made by the Swiss branch of the National Forest Society. The height, the basal area, the volume, the number of trees on the area and their diameter are all recorded by this Society for experimental purposes. Sixty per cent. of the revenue of the forest is derived from firewood, and 40 per cent. from matured timber.

On the 13th June Herr Tuchschmid kindly proposed to conduct us to the summit of the Rigi, and we left Sihlwald between 4 and 5 A.M., on a beautiful morning, and walked across the forest to the railway station at Thalwil, whence we took train for Arth-Goldau in the first instance. While waiting our train at Thalwil, it was interesting to notice on the north-going train from Italy, which passed through at the time, a large number of chickens which were being conveyed to Germany to be fed by the German peasants, and marketed in that country. From Thalwil the train skirted for a considerable distance the shores of the Lake of Zurich, through beautiful country, producing chiefly grapes and grass, until it branched off towards Arth-Goldau, the terminus of the ordinary railway line, and also the terminus of the Arth-Rigi railway. The station is situated on the site of the Goldau landslip, which occurred on 2nd September 1806. This terrible landslip descended from the summit of the Rosberg, and buried four villages with four hundred and fifty-seven of their inhabitants; and although time has covered the fragments of the rock with moss and other vegetation, the track

of the landslip may be distinctly traced on the side of the Rosberg, which is still entirely bare. The highest peak of the Rosberg is 5190 feet, and the scenery at this railway station baffles description for its variety and beauty.

After breakfasting at the station, we joined the mountain railway, the gradient of which is on an average 1 in 5, and at the rate of 4 or 5 miles an hour we were taken through most marvellous scenery till we reached the summit of the Rigi. Unfortunately, when we got to the summit we were enveloped in a cloud of white mist, so that little could be seen from the top, except mere glimpses as the wind opened the mist for a second or two, and thus enabled us to see how much we had lost by not being able to feast our eyes longer on the scene. On the summit there are several fine hotels, and a brisk trade was being done in picture postcards from quite a street of little tent-like stands which had been erected there. The mountain affords fine rich grazing, and carries a stock of four thousand cattle. They are all fawn-coloured, and it was very interesting to see them from the railway along the route, in small herds, the more sedate ones wearing bells.

By the railway on the opposite side of the mountain, which is also a rack and pinion line, and has even a steeper gradient than that by which we ascended, being 1 in 4, we descended to Vitznau. From Vitznau we embarked on the steamer and sailed down the lake to Lucerne, and had an opportunity of seeing with great clearness the mountain peaks which we missed on the summit, and the beautiful waterfalls at many places along the shores of the lake. We spent the evening at Lucerne in seeing the many interesting sights in the city, and we saw the mountain peaks in the light of the setting sun to great advantage. We had also the pleasure of a walk over the mediæval bridges which cross the Reuss at Lucerne, with the interesting scenes painted upon them in the eighteenth century. From Lucerne we trained to within a few miles of Sihlwald, and arrived at our pension at midnight, having spent a most interesting day.

On 15th June I again visited the saw-mills, and I was much struck to see the railway alongside the saw-mill, and only 2 to 5 yards from it in some places, laid with iron or metal sleepers, which showed how valuable the wood must be which was being prepared on the spot. I also saw the stables. They

were all situated underneath the dwelling-houses, as is the case in Germany; the ceilings were low, and there was little means of ventilation. The cows are also housed in a similar way, and they are never grazed outside except in the higher slopes of the Alps, where they graze as in Scotland.

On the 16th June I visited Zurich, and was shown over the technical school. The Forestry and Agricultural Department has small museums of plants, animals, and implements, but not nearly so large as those at Aschaffensburg which we saw last year. I also saw through the Botanical Gardens. They are small in size, and in the centre of the city, and many of the specimens, which did not appear to be thriving, were no doubt affected by the smoke. We noticed the effect of smoke in the same way on the trees on the highest reaches of the Abishorn.

Before taking leave of this forest, I may mention that it has a great variety of means of transport, each of which is suited to the topographical formation of the ground. The valley itself, with the State road and railway as its main arteries, forms an outlet for all the side means of transit, and these are made up of roads for waggons on its more accessible areas, tram-lines winding round its steeper slopes, and sledges and timber-chutes on its higher and more precipitous peaks. All these are of the very best of their kind, but the management is annually becoming more favourable to tram-lines of narrow gauge, and is using that mode of transit in preference to all the others. The waggon's own weight on the tram-line carries it to the depot. One man takes charge of each waggon, and he has a very simple and effective method of applying a brake to it.

The geological formation on which the forest-soil rests is a soft white limestone, which makes the higher peaks very liable to landslips, and the numerous streams to be cut into deep gorges. The streams are carefully protected by artificial means, and the forests on the peaks are managed on the selection system, whereby they are never cleared of trees. Unless this is carefully attended to, landslips causing great damage occur. Anyone who wishes to get a complete history and description of this forest should procure Herr Ulrich Meister's book, beautifully illustrated (but only printed in German), and published in Zurich.

On the 17th June I travelled from Sihlwald to Forbach in the Grand Duchy of Baden, leaving Sihlwald at 5.30 A.M., and reaching Forbach at 8.45 P.M. Shortly after leaving Offenburg we came into a forest country, and we travelled through forest nearly all the way. The land is high, forming steep banks on the water streams, and is thickly covered with open forests, the streams being used to drive the saw-mills, which were closely situated along the courses of the streams, and engaged in sawing up the timber.

The forest of the Schifferschaft is situated to the south of the village of Forbach, in the Murgthal, and the Grand Duchy of Baden. The Murgthal is a valley taking its origin in the Kingdom of Wurtemburg; it follows a northern direction, and, beginning fairly wide, it narrows down to a rocky gorge. In this valley the river Murg flows. In parts it is very wild and rocky, with numerous granite boulders scattered about its bed. In former times the river was used for floating down the timber. Dams were made higher up its source; these were suddenly removed, and the timber floated down in this way, but there are now so many weirs thrown across the river to obtain water-power for many purposes, that this mode of transit is no longer practicable. Almost the whole area drained by the Murg is covered with forest, which only ends when the valley merges into that of the Rhine. There are small pieces of agricultural land near the villages, and meadow land is scattered through the valleys in the forest, but these form a very small proportion of the whole, and agricultural operations have all to be done by hand, the ground being so steep and inaccessible. Round Forbach there are many of these small agricultural patches on the steep hill-sides on either side of the little town, and the agricultural operations are conducted chiefly by the women, who carry up all the manure on their heads to their little patches, which are beautifully cultivated, but at great expense in labour and industry. There is a very interesting wooden bridge thrown across the Murg at Forbach. It is built entirely of native timber, chiefly silver fir, and although it is more than a hundred years old, it is in a good state of preservation, showing the wonderful "life" of well-matured timber, even when exposed to the weather, and without any paint or varnish. The external boundaries of the forest are the water-courses or ridges. The boundaries are marked by beacons erected at certain intervals,

and between the beacons the line is kept open by a clear space about 2 metres wide. From time to time these boundaries are cleaned, that is, all the undergrowth is cut away. The beacons are cut from sandstone slabs, and are often painted white, and have the district number in black letters on the sides facing the compartments. The internal compartment boundaries follow the same natural divisions, or consist of cleared lines.

From what has been said about the Murg valley, it will be seen that the forest on the whole is on steep, sloping ground, except the plateau on the top. Up to an elevation of 650 to 750 metres (2130 to 2460 feet), the geological formation is granite. Above this level the granite is overlaid with old red sandstone, and in both instances the soil produced by the weathered rock is of very good quality. The height above sea-level varies from 320 to 1064 metres (1050 to 3490 feet). The climate on the whole is favourable. In winter there are heavy falls of snow; the summer is warm, and the rainfall heavy. Late spring frosts sometimes damage the shoots of the beech and the silver fir, but early autumn frosts seldom do any harm. Some injury is done by snow-breaks in winter, but not to any large extent. The trees that suffer most from this are Scots pine and spruce. The snow-covering in winter protects the silver fir from frost. Wind-falls occur frequently. The population of the town of Forbach and the surrounding villages is entirely dependent upon the wood industry. As has already been said, the little agriculture that is possible is carried on by the women in the various villages, while the men are employed in the woods or in the saw-mills and paper-mills. The forest is intersected by an excellent system of roads, drag-paths, and rides. Along the valley, near the river, the State road runs, and the forest roads are connected with it at intervals all along its course. The forest roads have been carefully constructed, at a cost of from $2\frac{1}{2}$ to 8 marks per metre (2s. 3d. to 7s. 4d. per yard), and they are kept in excellent condition. The drag-paths are of two kinds; those suitable for dragging timber in winter, when the ground is covered with snow, and not very steep, and those for summer use, which are constructed in the same way as those for winter use, but have a steeper gradient. The paths are fairly numerous, and thoroughly open out the forest. The rides penetrate the forest in all directions, and the gradients

vary considerably. Some are very steep, and logs are let down these steep paths by means of ropes.

As has already been mentioned, the population depends very much upon the work in the forests, and the wood-cutters work in "Rottes" or gangs of from eight to fourteen men each. The Oberförster sees that they are regularly supplied with work, and the felling is done by contract. The timber is marked by the Oberförster, who spends about forty days in the year at this work, and three or four of the principal men from the "Rottes" of wood-cutters accompany him. He walks through the compartments, selecting the trees to be felled, and these are forthwith marked by the wood-cutters by a blaze on one side, and a stamp on the roots by means of the forest-hammer. The labourers do this work gratis, or at least it is part of their contract. As the logs are marked, the wood-cutters call out to what assortment they belong, and the Oberförster notes them in his book.

Both summer- and winter-felling are practised. In November and December the cutters commence by felling the broad-leaved species—beech, maple, etc. Later on in the winter heavy snows very frequently prevent any work for some months, but if favourable conditions exist, the felled wood is sledged to the waggon roads, and stacked there. In spring the sledging and dragging work in the compartments is suspended on account of the young growth, as this is more apt to be spoiled at that stage than when the sap is fully up. The heavy coniferous logs are felled in spring and summer, and they are immediately barked and cut into the best lengths, the longer the better. The parts yielding firewood are loosely stacked, to ensure their drying speedily. The bark of the silver fir is sold for firewood. The bark of the spruce used to be sold for tanning purposes, but the demand is now so small that no market can be got for it for that purpose. The rough parts of the firewood are used for charcoal, and the better parts of it go to the paper-mills and for firewood for the villages. Spruce gives a finer and whiter paper than the silver fir. About the end of August, and during the month of September, the logs are all dragged out of the compartments to the various forest roads, and firewood and bark are transported on sledges. The headman of each "Rotte" contracts with the Forstmeister, and they supply all their own tools, and conduct the work under the supervision of the forest guards. Sometimes

the wood is measured on the ground where it has been felled; at other times it is measured after being brought to the roads. From time to time advances are made to the wood-cutters, and a final reckoning is made when the material is worked up at the end of the year. The average earnings are from 3 to 4 marks (3s. to 4s.) a day.

The chief injuries to which the crop is exposed are wind- and snow-breaks, bark beetles, and weeds. Herr Stephani, the Oberförster in charge of the forest, is assisted by an assessor and a staff of forest guards; and one of the latter does the book-work. The Oberförster has a beautiful residence in Forbach, and a liberal allowance is made so as to enable him to keep a sufficient number of horses for the purpose of getting about the forest quickly and comfortably. The forest is stocked chiefly by silver fir, which is estimated to extend to 51 per cent. of the whole. Spruce comes next, with about 37 per cent.; beech and other broad-leaved species with about 6 per cent.; and Scots pine with about 6 per cent. On the growing area the silver fir predominates to a still greater extent, reaching as high as 60 per cent. of the whole. Besides the above species, there are a few specimens of ash, maple, alder, hornbeam, and, on the higher slopes, birch and mountain ash.

The chief object of the management is to provide large-sized timber in the first instance to supply the various shareholders of the forest. The Oberförster says from his own experience, and from the history of the forest, that it has been found most profitable to continue cultivating indigenous species in the various localities where they are found. The sylvicultural system followed is a combination of the group and selection systems. As soon as a group is formed in a wood that is to be regenerated, the mother-trees are cut away gradually, with the double object of giving light to the young growth and to enable the remaining trees to become wind-firm and put on a larger increment. This is done leisurely, as it is desired to get as uneven-aged a wood as possible, provided no increment is lost. It is maintained that the nearer to the selection system one can get, the less danger there is from wind-fall. The young silver fir can stand the shade of the parent-trees for a great many years, but as soon as they are free from shade the young shoots grow rapidly, and the trees develop into splendid specimens. Natural regeneration is followed throughout, the only planting necessary being the filling

up of gaps and openings that occur from various reasons, such as wind-falls. Tending the woods under these circumstances demands great attention, and it is full of interest; and great judgment is required during the time the over-wood is still present.

In dealing with the group system, after a young crop has been established by cutting away the trees shading the centre, it begins to grow rapidly in height, the young shoots gradually getting longer and longer until the normal is reached. These groups are widened by gradually giving more light and by the removal of the mother-trees. Should any of the trees in the group show a tendency to branch, they are pruned, a procedure which is frequently required in the case of the silver fir. While the crop is still young, weeds, such as the sallow and other undesirable species, are cut out, and all material damaged by the felling of the over-wood is also removed. When all the old wood has been removed from the compartment, very little is done, and suppressed trees are often left for a long time in the groups, as it does not pay to cut them out. When the trees have reached a considerable growth they are thinned, so as to encourage a good increment and to become wind-firm; and as a result a young dense wood is led over to an open wood, and the result is that the soil is again gradually covered with a growth of trees to be used for the next crop. The rotation extends to about 120 to 140 years.

As has been already stated, the population depend upon this industry for their living, and the wood-cutters, growing up from infancy in the forest, are very skilful; and as the work is done by contract, and every man knows the best way to fell a tree and cut it up so as to yield the most valuable assortment of timber, a very limited supervision is necessary. The forest guards do all the superintendence, and as they are drawn from the ranks of the wood-cutters, they are thoroughly acquainted with the details of the work they are called upon to supervise. It often happens that a number of trees are blown down by the wind, and then the wood-cutters' first duty is to have them cleared from the roads and ridges, and afterwards the isolated trees scattered about the forest are removed in order to prevent them from doing harm to the young generation. All these logs are barked, and are cut into assorted sizes before the men proceed with their regular fellings. The

method of felling is very much the same as that practised in this country, by axe and saw. Scattered about the felling areas are temporary depots to which all the material is brought by contract, the cost being about 2 marks per cubic metre ($\frac{2}{3}$d. per cubic foot) for the large timber. Various means are adopted for conveying the timber, such as carrying, sliding, dragging, sledging, and letting it down steep precipices by ropes, and the transport of wood from the depots is effected by means of waggons drawn by oxen and horses. All the first and second class logs of heavy timber are delivered to the shareholders of the forest in numbers proportionate to their shares, and they themselves are at the expense of removing the logs from the depots. The other produce, such as firewood, bark, etc., is sold by auction or missive in the forest, and the net revenue from these sources is divided amongst the shareholders. The saw-mills and paper-mills along the valley are driven chiefly by water-power, although some of them have engines to augment their power. All the mills are the property of private owners, and the paper-making industry is increasing annually.

Herr Stephani, the officer in charge of the forest, drove us, two days in succession, to two districts of the forest, a new one each day, and he was most attentive and kind in giving us all the information we desired. In the course of these drives, and in the long walks we took from point to point in the course of the day, we saw the forest nurseries, which are very small, and are only meant to supply a few plants to make up places where regeneration has failed from one cause or another. The effects of the gales were well illustrated at a place where a new road had been cut into the forest, and where the opening had admitted the wind, which had cleared a large area of valuable timber before its time No matter how skilfully severance cuttings are made, they do not prevent loss by gales, and hence the adoption of the method of group-selection and regeneration described above.

Well-grown Scots pine is worth 32s. per cubic metre (11d. per cubic foot), and spruce and silver fir are worth about half that price in the wood.

As showing the size of the timber, I may mention that we saw a silver fir which had been felled and peeled, and which contained 560 cubic feet of wood. This was an exceptionally large tree, but most of them contain from 400 to 500 cubic feet

after being peeled and dressed. Many of the trees reached a height of 35 metres (115 feet). The forest realises 112 marks per hectare of net revenue, which is equal to about 45s. per acre.

On the 21st June there was a church festival, and all the population of Forbach were taking part in it. Being a holiday, I took the opportunity of travelling homewards, and after a fortnight of great interest, both as regards Sihlwald and Forbach, I would say what Professor Blackie said about Stromness and John o' Groats—"Comfort there with kindness cheaply dwells."

XXIX. *Example Plots or Forest Gardens.*

By Lieut.-Colonel F. BAILEY.

As misconception appears to prevail in some quarters in regard to the purpose for which "Example Plots" are required, and consequently as to the localities in which they should be established, I take this opportunity of explaining how, in my opinion, this question stands.

The impossibility of giving effective practical instruction in Modern Scientific Forestry, in the absence throughout the country of timber-crops which have been raised in accordance with its tenets, is universally admitted. As a means of overcoming this difficulty, the Forestry Committee (1902) recommended the formation of—

(1) "*State Demonstration Forests*," or large areas (2000 to 10,000 acres) of woodlands, in which every proved and appropriate method for economical and effective working, and the utilisation of forest products, would be employed, under competent direction, and which would be made use of as educational object-lessons. They would be managed according to a working-plan, drawn up so that the area should yield as large a profit as possible. These forests would, as a matter of course, comprise nurseries, and a portion of their area would, no doubt, be set apart for experimental purposes. Nothing more need be said about these forests at present.

(2) "*Example Plots*," regarding which it is necessary to go a little more into detail. The paragraphs of the Committee's Report which deal with these plots run as follows:—

15. Even where access may be had to private woods, it is exceedingly desirable that collegiate instruction in forestry should be illustrated by means of example plots (the German *Forstgarten*). These are a considerable feature of the teaching in the University of Giessen and elsewhere on the Continent, and they have been reproduced on a small scale at Coopers Hill and on the Northumberland Demonstration Farm. If each plot be made of sufficient size, say three acres, it is capable not only of demonstrating principles and the effect of mixing and management, but also, within limits, of yielding comparative financial results. A total area of 100 to 200 acres *at each centre* would be necessary and sufficient for this purpose. In confirmation of this opinion, Professor Schwappach allows us to quote his view, that the plots at Giessen (the whole area of which is only 16½ acres) are too small, and that the serious effects of curtailed space are already being felt. We have made an inspection

of several areas of land *near Cambridge*, one of which could doubtless be bought for such a purpose, and similar facilities could probably be secured *near Edinburgh and other centres of instruction.*

. . . . . .

20. We have stated that we consider it necessary to have "Example Plots" in connection with the universities and other centres of instruction, as well as two large State Demonstration Areas; and it may be well here to explain why both are required. The Example Plots should embrace a comparatively small area, and comprise an arboretum or collection of specimen trees, and also an area devoted to the experimental planting and growth of trees in masses up to a certain age. Such an area cannot, from the very nature of the objects aimed at, be expected to yield a profit. . . . Forest students from the universities and others would spend a week or two at a time, or longer, in the Demonstration Forest; but they and the lecturer also require an area *close at hand*, to which resort can be more frequently made.

36. Our conclusions may be summarised as follows:—

We recommend—

. . . . . .

(*b*) . . . that Example Plots, as defined in paragraph 15, be provided *in connection with each of these centres* (*Cambridge and Oxford*), *and with Edinburgh.*

The italics in the above extracts are mine.

A perusal of the above extracts leaves no doubt that the Committee intended each teaching centre to have its own "Example Plots" or Forest Garden (as I prefer to call it), and that they intended these gardens to be "close at hand," so that frequent visits to them might be made. It is, indeed, essential that lectures should be "illustrated" by means of such gardens; because in regard to most of the subjects dealt with by the lecturer, clear and abiding ideas cannot be imparted by means of class-room lectures alone, nor otherwise than by frequent visits with the lecturer (or without him in any spare time the students may find) to some place where practical illustrations may be seen. Students must make themselves thoroughly familiar with the appearance at different seasons of the year, and with the rate and manner of development in crown and root, of the various species up to the age at which they are to be found in the Garden. They must also be familiar with the behaviour during youth of the various species when grown in mixture, and with their effect on each other. They should also do nursery work, planting and direct sowing, with their own hands.

The time of students is usually very fully occupied. They have many lectures to attend in addition to those given by the teacher of Sylviculture, so that excursions to a distance cannot

often be undertaken; and when time for such excursions is available, the sylviculturist has to compete with other lecturers—the botanist, the geologist, the entomologist, the surveyor, the engineer, the agriculturist—for their attendance. Hence it is evident that unless the Forest Garden be "close at hand" effective practical instruction in elementary forest work cannot be given.

If a Demonstration Forest were "close at hand" there would evidently be no need to provide a Forest Garden; for in the former would be seen all that the latter could show, and a great deal more in addition. But there is no hope that a large forest area could be established in the immediate vicinity of any of the present teaching centres, and hence arises the necessity for each such centre possessing its own Forest Garden, in which the lectures given can receive due practical illustration up to a certain point in the development of a forest crop. If the Forest Garden is not near enough to the lecture-room to serve this purpose, it would be sheer waste of money to establish it; for if a visit to it involves a prolonged absence from headquarters, it would probably be almost as easy to go to the Demonstration Forest, where, as I have said, much more could be seen. The Forest Garden at Giessen is about two miles from the university, and the Garden at Oxford lies at a distance of about 2½ miles from the centre of the university.

I am not, of course, unaware of the high cost of land in the immediate vicinity of a town, and I do not expect a Forest Garden of 100 to 200 acres at the door of my lecture-room; but I desire to urge that the Gardens should be located *as near as possible* to the lecture-rooms, no attempt being made to adapt one such Garden to use by two or more teaching centres. And I may add that I would rather content myself with an area one twentieth (or even less as a temporary provision) the size of that recommended by the Committee, taking my chance of future extension, than accept the larger Garden situated at a distance which would render it very much less useful to me.

XXX. *Training of Foresters.*

By J. PARRY, M.Inst.C.E.

With reference to a letter which appeared in the *Times* of 21st March, the Hon. Editor has been good enough to call my attention to an address delivered by the late Earl of Mansfield at the Annual Meeting of the Society in January 1900. In that Address, which I had not previously seen, his Lordship advocated a distinction being drawn between youths employed in forestry, and those who are never likely to be, or to desire to be, more than ordinary estate labourers, and he suggested a system of three years' apprenticeship, on the termination of which the apprentices should be entitled to a certificate.

Now I have already commenced on a small scale, both at Rivington, in Lancashire, and at Vyrnwy, in Montgomeryshire, a system of apprenticeship on the lines suggested in my letter to the *Times*. And my immediate difficulty is how to provide those boys with suitable technical training. There is no technical school within convenient reach to which they could go for instruction in the evening, and their parents are too poor to pay for an occasional term at a technical school distant from their place of abode. The same difficulty will arise all over the country, and a solution must be found if forestry is to make the progress we all desire.

It appears to me that something may be done in this direction with the assistance of the Education Department, without waiting for the carrying out of the larger and more ambitious scheme of a Central Board with its ramifications. The Board of Education is at the present time in a progressive mood, and there are Members of the Cabinet who are known to be in hearty sympathy with afforestation. If important bodies like the Royal Scottish and English Arboricultural Societies would unite in recommending a practical scheme which would not involve new machinery or increased expenditure, I see no reason to doubt the willingness of the Government to assist in carrying it out.

[For the Address by the late Earl of Mansfield to which Mr Parry refers, see Vol. XVI. p. 156. See also Vol. XVIII. p. 51, "Conference on Forestry Education," and the section "Forestry Education" at p. 3 of the Society's *Proceedings* which form part of that volume.

We welcome the expression of Mr Parry's views on this important question. His letter to the *Times* is given below.—HON. EDITOR.]

TRAINING OF FORESTERS.

To the Editor of the "Times."

SIR,—The influential deputation which waited upon the Chancellor of the Exchequer recently to state their views on afforestation, had for their chief object the establishing of a strong Central Board of Forestry supported by a substantial grant of public money. The attainment of this object is undoubtedly of great importance, and it is hoped that Mr Asquith will be able to show his practical sympathy with the movement in his coming Budget

The deputation also referred incidentally to the urgent necessity of means being provided for training experts to meet the growing demand for a more systematic and scientific method of planting than has hitherto obtained in this country. Now, in connection with this branch of the subject, it appears to me that, pending the carrying out of the large scheme for a Central Board, and without in any way slackening the efforts to obtain the full financial help asked for, substantial progress might be made through and with the assistance of the Education Department of the Government.

The country is, I believe, being gradually aroused to the danger of neglecting to produce home-grown timber for the requirements of the future. The Chancellor of the Exchequer mentioned several places where schemes are now being worked out with promising results; and it is satisfactory to know that effect is being given to one of the recommendations of the departmental committee on Forestry, advocating the planting of the upland areas from which water supplies are derived for our large communities. Leeds, Birmingham, and other towns have already followed the example of Liverpool, and several more towns have projects under consideration. Enterprising landowners are also moving in the same direction, and as soon as capitalists become alive to the commercial advantages of planting in lands that can be bought for a low price, there will certainly be a rapidly increasing demand for trained men.

What I have to suggest to the societies who were represented by the deputation is that the time has arrived when, in consultation with the Education Department, they should formulate a scheme of education to include all the grades of men required for carrying out scientific afforestation, and that they should endeavour to secure the co-operation of the Education Depart-

ment in giving effect to the scheme through the County Councils. The grades to be provided for comprise working apprentices, working foresters, foreman foresters, head foresters, inspectors of forestry.

It should, I contend, be the aim of all who are engaged in afforestation to create a class of apprentices, instead of merely taking on boys to drift into the lot of common labourers. If we are to make the planting of trees a skilled calling, the apprentices must be properly taught, just in the same way as apprentices to plumbers or carpenters. But as the planting operations are carried on for the most part in remote country districts, the working apprentices will be sons of agricultural labourers and shepherds, who cannot afford to send their boys to a central technical school, and some local provision should be made for them.

Since I gave evidence before the Departmental Committee, I have had opportunities of considering, in the light of experience, the difficult problem of obtaining suitable theoretical instruction for apprentices to working foresters. There is not, so far as I can see, any one available to impart instruction except the master of the nearest elementary school; but there does not appear to be any good reason why he should not, if supplied with proper text-books, be capable of guiding the student in acquiring elementary knowledge of botany, leaving the head forester under whom the apprentice is serving to give the necessary practical illustrations. A large majority of apprentices will not go beyond this, and they will form the rank and file of working foresters. For promising students there should be scholarships available in the nearest School of Forestry, under the direction of the County Councils, and these students would work their way to a higher grade. The head foresters and inspectors of forestry must, as a matter of course, be trained in the forestry department attached to universities, and they should be required to possess diplomas to show that they have thoroughly studied their subject, and have acquired a practical as well as theoretical knowledge of the best home and foreign practice.

I am, your obedient Servant,

J. PARRY.

Liverpool Corporation Water-Works,
Municipal Offices, Liverpool.

XXXI. *Deputation to the Chancellor of the Exchequer.*

By the PRESIDENT.

On 30th March 1906 a deputation of members appointed by the Royal Scottish and the Royal English Arboricultural Societies waited on the Chancellor of the Exchequer at his room in the House of Commons. The members of the deputation were as follows:—From the Royal Scottish Arboricultural Society—Lord Lovat, Sir Herbert Maxwell, Mr Munro Ferguson, and Mr Steuart Fothringham; and from the Royal English Arboricultural Society—Professor Fisher, Mr Elwes, Mr Marshall, Mr Havelock, and Mr Davidson. Mr Fraser Story, from the Bangor University, was also present.

Before meeting the Chancellor of the Exchequer, the members of the deputation met at Mr Munro Ferguson's house, and decided that the principal points to bring to the notice of the Chancellor of the Exchequer were—(*a*) the necessity for a responsible authority to deal with forestry, either as a separate Board of Forestry, or as a special department under the Board of Agriculture; (*b*) the carrying out of the recommendations of the Departmental Committee of 1902; and (*c*) the provision of forest areas in England and Scotland for instruction and experimental purposes.

The deputation was introduced by Sir Herbert Maxwell, who then spoke, and began by drawing attention to the deficiency and diminishing supplies of timber in Great Britain and other countries, and to the serious effect this deficiency would have on many trades, unless steps were taken to increase the supplies. The deficiency was shown by the large and increasing imports of timber into this country, while even in France and Germany, where there were large and well-managed forests, the supply was not equal to the demand. If good methods of forestry were introduced and carried out in Great Britain, as was done under Government auspices in most of the other countries in Europe, a considerable part of this deficiency might be made good by home-grown timber; for the soil and climate of these islands was as suitable for timber-growing as were those of other countries in Northern Europe, and no time was so favourable as the present for making a start in forestry on a large scale, as much land that was formerly valuable for grazing was now,

owing to the unprofitable nature of sheep farming, depreciated to such an extent that it could be bought more cheaply than at any other time in his experience. Sir Herbert further pointed out that where one man was employed as a shepherd a considerable number of men would be employed on the same extent of land under afforestation, which would tend to check the flow of population from the country districts to the towns.

Mr Munro Ferguson, who followed, especially urged the necessity of a responsible authority to take charge of forestry, either by the appointment of a Board of Forestry, or the formation of a special department within the Board of Agriculture. The necessity for such an authority was shown by the fact that he and others interested in the question had for years been trying to bring the matter before Government, and had been sent backwards and forwards between the Office of Woods and Forests, the Board of Agriculture and the Scotch Education department, and all with very little result. He further asked that a sum of £100,000 should be set aside for the purchase of suitable areas in England and Scotland for educational and experimental purposes, and a sum of £10,000 a year to equip and maintain them until they become remunerative. He thought these were the smallest sums for which the recommendations of the Departmental Committee of 1902 could be carried out.

Lord Lovat asked that the department charged with the care of forestry should carry out experiments in different parts of the country and at different altitudes, and should furnish the results of these experiments to proprietors who were desirous of afforesting their land. In the meantime, owing to the lack of foresters of sufficiently varied experience, each proprietor had to make experiments for himself, and a great deal of time was lost before he could get any reliable results. He also pointed out that afforestation would give employment to many men in the Highlands of Scotland at a time of year when employment is scarce. During the summer and autumn many men got employment on the land, and in connection with sport, but afforestation would afford them employment in the winter months during which they were now idle.

Mr Steuart Fothringham pointed out that if schemes of afforestation were to be undertaken, either by the State or by private individuals, it was necessary that they should be under the supervision of competent foresters. It was most important

that the first schemes that were undertaken should have every chance of being a success, as if they were a failure the whole question of forestry would be set back for a long time, and he urged that, even if the purchase of forest areas could not be carried out immediately (and the preparation of such areas for afforestation would take some little time), a scheme of systematic training in forestry should be at once instituted, so that there might be a body of trained foresters in the country capable of carrying out large schemes of afforestation with the best prospects of success.

Professor Fisher spoke on the subject of forestry education, and drew attention to the Forest schools in France and Germany, and to the advances that were being made in Belgium, where the conditions of soil and climate most nearly resembled those that prevailed in England. The authorities at the Forest of Dean gave some training to foresters, but only to those to be employed on their own area. Oxford University had devoted some land to the purpose which was available for the Indian students, but more land and more forests were necessary. There were no Crown forests in Scotland, and very few in England. Ireland had not been included in the present deputation, though it was, from climatic and other considerations, most suitable for forestry operations, because it was understood that some steps were being taken by the Irish Local Government Department.

Mr Elwes said that he could speak from personal observation as to the failing supply of timber, as he had visited nearly all the timber-exporting countries in the world, and they all told the same tale, that the demand was increasing and the supply decreasing, though both in the United States and in Canada some steps were being taken to prevent further waste of the existing supplies. There the area from which the best supplies were drawn was diminishing, and the same applied to Northern Europe. He also drew attention to the unfair incidence of taxation on land given up to afforestation, both as regards rates and succession duties, and pointed out that the timber industry was severely handicapped by the heavy railway rates charged in this country.

Mr Fraser Story asked that further facilities should be given for the technical instruction of foresters in Wales. They had at present an area of 50 acres, given by a private individual, but

though he thoroughly appreciated the generosity that had prompted the gift, and was sure that it would be very useful, it was at such a distance from Bangor University that the students could not get sufficient opportunities of going to visit it, and he asked that more instructional areas should be provided.

The Chancellor of the Exchequer thanked the deputation for their attendance and for the information they had given him. He assured them that the Government looked upon the subject of forestry with sympathy, and that the question of a special authority or Government department for forestry would receive his careful attention. He pointed out that facilities for instruction were given at Oxford University, at the Forest of Dean, at Bangor University, at Edinburgh University, and at Glasgow and Aberdeen; that the Crown woods at High Meadows and Alice Holt had been put upon a working-plan, and that the Office of Woods and Forests were looking for a forest area in Scotland, but had not yet been able to find a suitable place. Large sums of money had been mentioned by Mr Ferguson, who had added that they were the minimum sums required to carry out the Report of the Departmental Committee of 1902, but there were difficulties in providing these sums out of the National Treasury. The Government looked with sympathy on schemes for preventing the exodus of the country population to the towns, and he promised that the whole matter should have his careful attention.

Sir Herbert Maxwell thanked the Chancellor of the Exchequer for his patience in listening to the deputation, and added that they were not asking for a dole for forestry, but for a grant to enable the country to undertake a business that was remunerative in other countries, and which he believed would, in the future, be remunerative in Great Britain also.

XXXII. *The Irish Forestry Society.*

State Afforestation—Deputation to the Chief Secretary for Ireland.

A deputation from the Irish Forestry Society waited on the Chief Secretary at Dublin Castle on 23rd April, for the purpose of urging the advantages of State afforestation and its application to Ireland. The deputation consisted of the Right Hon. Lord Castletown, Messrs O. H. Braddell, Wm. Dick, Charles Dawson, Prof. Houston, R. E. Hodson, J. P. Jones, J. Scott Kerr, A. E. Moeran, Geo. Perry, J.P., and A. H. Walkey.

Lord Castletown said the object of the deputation was to bring before the Chief Secretary the advantages of State afforestation. The Commissioners of Woods and Forests had power to buy land under section 4 of the Act of 1903, and they might be induced to ear-mark and utilise all those funds which were now coming in by the redemption of Quit and Crown rents, for the particular districts from which they came. The Commissioners of Woods and Forests could, by utilising the clauses of the Crown Lands Act, carry out the policy laid down in the Act of 1903, and create a really sound scheme of State afforestation. They could do that, he thought, without infringing in any way on Treasury finances or asking for any grant.

Mr Scott Kerr said the scheme which the Society advocated was drafted in response to the requests of a large number of public men during the last few years. The Society appointed a sub-committee to go into the matter and prepare a scheme which would form a basis of future State development in the matter of forestry. About a million of acres had been transferred from the former owners to the occupiers, and no provision, as far as they understood, had been made for the afforestation of this great amount of land. If the present procedure went on, many opportunities of doing good work in the direction indicated would be lost for ever. The speaker went on to refer to the details of the scheme.

The Chief Secretary said he was entirely with them as to the general desirability of action in the direction suggested, and it would be better if the speakers confined themselves to the practical aspects, showing what could be done, the way in which it could be done, and the prospects of remuneration.

Mr Scott Kerr said he was glad to hear that the Chief Secretary was with them so far. Continuing, he mentioned that if they succeeded in carrying out this scheme or some other, one of their first objects would be to endeavour to arouse public feeling in the minds of the people to make them protect the timber already existing, and give a more sympathetic consideration to afforestation generally.

Mr R. E. Hodson said he had no hesitation in saying that with land ordinarily adapted to planting, with the exercise of ordinary intelligence and the existence of reasonable communication for thinning portion of the crop, money expended in afforestation would bring in an ample and certain return. It would give healthy and remunerative employment at periods of the year when the farming interests would not be affected by the withdrawal of the men, and, in addition, it would give employment in the homes of the working and labouring class and the small farming class, all of whom wanted it badly. The question of shortage of timber was also one of importance in this connection.

The Chief Secretary said that that was so. He had given a good deal of attention to the matter, and could say that there was a serious risk of having a shortage of timber within the next thirty or forty years.

Mr Hodson also referred to the importance of having wood as fuel in many parts of Ireland.

Mr A. E. Moeran said that the price of timber had greatly risen of late, and was still rapidly advancing. A thorough system of planting all over the country would be of the greatest benefit to farmers, because the work of forestry would be carried on in winter, and the men engaged at it would be free when the farmers required them in summer.

Mr George Perry said the matter should be commercially treated. He quoted figures to show the great importation of wood coming into Ireland, and said that much of this material could easily be grown at home.

The Chief Secretary, in reply, said he was entirely with the deputation in opinion and sentiment, for he had thought for a great many years that they were neglecting a source of natural wealth in every part of the United Kingdom which might be very largely developed, and which the example of other countries showed had been developed. He did not think that

any country, and certainly no part of the United Kingdom, needed so much as Ireland did the operation of this question. There was a good deal of wood in many parts of England, not so much large plantations, but the country generally was better wooded. Some forty years ago there began to be a tendency to cut down hedgerows, which they thought were injurious to the crops, but they had found that the absence of these hedgerows had caused a diminution of birds and a consequent increase in grubs and malignant insects, and so the cutting had been largely stopped. Since the eighteenth century there had been a great deal of planting in Scotland, though a great many parts of the Highlands were still sparsely wooded. He was much struck of late in travelling through Ireland to notice the barrenness of many parts of the country. Before the Anglo-Norman invasion Ireland was a very highly wooded country, and her barrenness in the matter of woods at present was a strong reason why something should be done to improve the state of affairs in that respect. He was inclined to believe that the price of wood would increase, as the demand was not likely to diminish, and the supplies in Canada and America had been greatly reduced. While agreeing with the deputation on the general question, they should all feel that consideration must be paid to the practical question. There was still much difference of opinion on the question of making forestry work remunerative. Then the question of whether the conditions which existed in France and Germany existed here was one that had to be considered. He thought they wanted rather more positive and definite scientific information than they yet possessed as to the possibilities of timber-growing in Ireland before they could expect the Government to enter upon any large policy. He had been considering since he came to Ireland, whether there was a necessity for having a small committee of specialists to examine the question further, and make a statement as to the commercial side of the matter. He would be glad to receive any hints later on from the members of the deputation on this question. There should then, he thought, be a more systematic examination than hitherto, as to the spots and soils in Ireland where planting would be most remunerative. It was a melancholy thing that the small tenants should be cutting down trees for the sake of the very small gain at present derived, when these trees would, very probably,

be of greater commercial advantage later on. While he would be glad of any further information that they might supply him with, they might be sure that the subject would not escape his attention. He was anxious to do something while he was here.

The deputation then withdrew.

The Annual Meeting.

The fourth annual meeting of the Irish Forestry Society was held on the same day in the Mansion House. Lord Castletown presided. Amongst others present were—Professor Houston, Messrs O. H. Braddell, William Field, M.P.; Charles Dawson, C. G. Grey, J. A. P. Jones, William Dick; J. Scott Kerr, Hon. Secretary; A. E. Moeran; A. H. Walkey, Secretary; and Miss Grey.

Lord Castletown referred to the deputation to Mr Bryce, who, he said, was thoroughly in sympathy with their views. It might be well if they could make some arrangement by which one of the points mentioned by the Chief Secretary could be answered by the Society. The Chief Secretary referred to the fact that there was a great divergence of opinion as to what districts could be most profitably planted. He thought the Irish Forestry Society was eminently qualified to give a clear and distinct answer to that. The members lived in different parts of Ireland, and each member could ascertain what area in his own district could be profitably planted, and which could be obtained at no great cost. One of their great difficulties would be, when it came to a question of the acquisition of land, to get land on which there were no great over-riding rights. The moment they tackled the rights in connection with land they met with a great deal of difficulty. The Society worked for the future and for the good of the people who lived in the country, and if their schemes were adopted they would be more likely to stem the tide of emigration than by any other means he knew.

Mr Field, M.P., moved and Mr Moeran seconded the adoption of the Report. The Report was adopted.

Mr Braddell moved and Mr Scott Kerr seconded the election of officers and committee.

Lord Castletown, in putting the motion, said that they had to drive the State to do its work in this country. The Forestry Society was beginning to succeed in its work. In 1905 he

received in the House of Lords an answer in reference to the revenue from the Crown and Quit rents exactly the opposite to that which Mr Field received in the House of Commons. The Earl of Denbigh on that occasion said: "Under the Crown Lands Act, 1829, the sums received under the heads referred to must be invested in the purchase of lands and hereditaments or the redemption of charges or incumbrances on land already belonging to the Crown." In 1906 the dodging answer the Treasury gave was, that this money was absorbed in the general taxation of the country. The great thing was to keep hammering at them. He appealed to Mr Field to ask Mr Redmond and others to work up the matter.

Mr Field, M.P., having been moved to the second chair,

Mr Dawson proposed a vote of thanks to Lord Castletown, and referred to the good work which had already been done by Lord Castletown in the matter of tree-planting and the starting of industries connected with it.

Mr Moeran seconded the vote of thanks, which was unanimously adopted.

XXXIII. *Memorandum as to the Law relating to Trees, Woods and Plantations in Scotland.* By ROBERT GALLOWAY S.S.C., Edinburgh.

According to the old institutional writers, such as Stair, Erskine, Bell, etc., woods and trees are regarded as *partes soli*, *i.e.*, pertinents or parts of the lands on which they are growing. Hence trees planted on one's ground, though not by the proprietor, are deemed as an accessory of the ground on which they are planted after they have taken root in and drawn nourishment from it, and so belong, as an accessory of the ground, to the owner of it. Various questions have arisen between fiars and liferenters, heirs of entail, and landlords and tenants, regarding woods, etc.

I. FIAR AND LIFERENTER.

As a general rule, a liferenter must preserve the trees and woods on the lands, and can only ingather their produce, such as shed leaves, mast, and fallen branches, but this general rule is subject to the following exceptions:—

(1) *Silva cædua*, or coppice wood, part of which is cu annually or at fixed intervals, and has always bee regarded as a crop, provided the liferenter is in posse sion when the usual period for cutting arrives. He not entitled to anticipate that period.

(2) Underwood or brushwood, and ordinary wind-falls.

(3) Matured wood and extraordinary wind-falls may claimed by the liferenter for the upkeep of the hou etc., on the property, but notice must be given to fiar before these can be taken.

A fiar claims wind-falls caused by extraordinary storms liferenter is not entitled, at his own discretion, to thin pl tions, but is entitled to do so at the sight of the fiar to who thinnings belong.

II. HEIR OF ENTAIL AND NEXT SUBSTITUTE.

An heir of entail is a limited fiar. Lord Ardmillan d his position in Boyd, 1870, 8 M. 637, thus:—"The

possession is entitled to cut wood, and to do so to a very considerable extent. Indeed, if he cuts ripe wood such as a proprietor in fee simple may fairly be expected to cut, and does not anticipate the proper time for cutting, and dispose of wood before it is ripe, so as unfairly to benefit himself at the expense of his successors in the entailed estate, I think that his right and power to cut wood is very wide, and that this Court cannot in the general case interfere to restrict it." But the heir in possession will be prevented from cutting such trees as are "required for the reasonable enjoyment of the mansion-house by persons in the rank of life which the inmates of such a house may be supposed to hold" (Lord Deas in the above case). Prohibitions as to cutting, if properly constituted in the deed of entail, will be given effect to as far as possible. Cutting unripe timber is not considered a proper act of administration, and the heir of entail would be restricted from so cutting. The heir of entail is only absolute owner of cut wood, hence the right to cut ceases with his death, and no further cutting is allowed although the wood has been sold. A trustee for creditors may exercise the heir of entail's rights of cutting. Individual creditors, it is thought, may adjudge the faculty of cutting.

III. Landlord and Tenant.

In leases between landlord and tenant the woods are almost invariably reserved to the landlord. If the tenant has any rights at all in the woods on his farm, they can only be used for the benefit of the holding.

Outlay on Planting.

Heirs of Entail.—Under the various Entail Acts the heir in possession is entitled to charge the estate, exclusive of the mansion-house, offices, and policies, with the expense incurred on planting. He may do so in the following manner:—

(1) By an annual rent charge extending over twenty-five years, at a rate not exceeding £7, 2s. for each £100 of outlay, including the whole expenses of the loan; or

(2) By bond and disposition in security for three-fourths of the outlay and three-fourths of the expenses; and

(3) An heir in possession, who has paid one-fourth of the capital charged under a rent charge, is entitled to

convert the rent charge into a bond and disposition in security over the property, but the expense of converting the loan cannot be included in the bond.

Private Proprietors.—Private proprietors are, of course, unfettered as to their expenditure on their woods, and their methods of carrying it out.

Every Landlord, so long as he has not less than a liferent interest in the land, may borrow money for planting, and charge the sum on the estate, either by applying to the Board of Agriculture or to one of the Improvement Companies, the only one in Scotland being The Scottish Drainage and Improvement Company. At first only planting for shelter was considered a proper outlay for such a charge, but now the power of borrowing has been extended to cover the expense of all planting approved of by the Board. Originally, also, the repayment extended over twenty-five years, but now the Board of Agriculture has power to extend the time to forty years. According to Major Craigie the rate of interest is about $3\frac{3}{4}$ per cent., which over the forty years period would amount to a charge of £4, 17s. per cent., and over a twenty years period to a charge of something like £7 per cent. The charges of the Scottish Company are as follows:—For twenty-five years, £5, 19s. 1d. per cent. per annum, payable half-yearly, for advances of £300 and upwards, and £6, 14s. for advances under £300; for a forty years period, £4, 11s. 6d. per cent. per annum, payable half-yearly, for £300 and upwards, and £5, 8s. 3d. under £300. These rent charges take priority to all other charges except feu-duties and such like, on the principle that the improvements effected on the property by the expenditure of the money add to the security of other creditors.[1]

Heritable Creditors.

Sometimes, but not often, questions arise between a proprietor and a heritable creditor as to the cutting of woods on the estates over which the heritable creditor holds a security. Such a case

[1] Operations under this system have been almost wholly confined to agricultural improvements. Major Craigie says, "The amount of money borrowed for planting is excessively minute. The total sum spent on planting from the beginning of the system, more than fifty years ago, does not yet reach £100,000."

came before Lord Kincairney in the Outer House on 21st November 1903 (*Neilson* v. *M'Nab*), reported in the *Scots Law Times*, vol. xi. p. 387. The complainer asked for interdict against the respondent cutting down the growing wood on the estate of Calderwood, in the immediate neighbourhood of Calderwood Castle and avenues or entrances thereto, so as to depreciate the value of the estate, and reduce the value of the security held by the complainer, and "in particular from cutting down the growing wood" on a specified area, until it should be fixed by the Court whether any, and, if any, what part of the said wood is ripe and fit for cutting, and not necessary for the residential character and comfort of the said Calderwood Castle, etc., and can otherwise be cut consistently with the just interests of the complainer as heritable creditor.

Lord Kincairney, in giving judgment, pointed out that where a heritable creditor becomes dissatisfied with his security he has various remedies—

(1) He can call up his bond;
(2) He can enter into possession;
(3) He can sell under the powers of sale in his bond;
(4) Raise an action to prevent by interdict the dilapidation of the estate.

Then he goes on to say, "I think it clear that the Court will not interfere with the proprietor so long as he confines himself to legitimate management. . . . He may manage his woods, and sell his trees for immediate profit when he sees occasion. Certainly his discretion will not be lightly interfered with at the instance of a heritable creditor. But I assume, without deciding the point, that a proprietor who has burdened his estate may be prevented from cutting the trees on it wantonly and recklessly, or even for present profit, if he thereby unduly reduces the capital value of the estate, and reduces or endangers the security of a creditor." It was argued for the respondent that the Court will not interfere with an owner on application of a heritable creditor, unless he can show that his security is being destroyed or imperilled; and his Lordship remarks, "that principle appears to be established by the English authorities referred to (Bewas on Waste, 1894: *Hampton* v. *Hodges*, 1803, 8 Ves. 105; *Hippesley* v. *Spencer*, 1820, 5 Maddox, 422; *King* v. *Smith*, 1843, 2 Hare, 239). The complainer referred to Harper, 15th May 1886, 54

L.T. 383, in which an injunction was granted against cutting timber, but in that case the security was admittedly insufficient. The only Scotch case referred to was that of *Macqueen* v. *Tod*, 6th July 1899, 1 Fr. 1069. This was a case in which a *curator bonis* was in possession on behalf of an heir of entail, who was insane and was eighty-five years of age, and it was accordingly held that it was the duty of the *curator bonis* to preserve the estate as he found it. Lord Kincairney goes on:—"In truth I do not see that in cutting his woods he (the proprietor) has done anything wrong at all, or that any exception can be taken to what he has done and his mode of doing it; and I think, so long as he keeps within his legal rights, there is no ground for interfering with him from apprehension of what he may do in the future."

It will be seen from the above that the principle laid down by the institutional writers was clearly in the mind of Lord Kincairney, viz., that the woods were looked upon as part of the estate.

Reform Suggested.

The alteration required on the law is the adoption of the principle that where woods are being managed under a proper working-plan, approved of by some responsible authority (such as the proposed Board of Forestry), they should be looked upon, not as part of the land as at present, but as a crop. The old principle should still be maintained, however, where the woods are not so managed, or are merely there for amenity, shelter, or as game preserves.

XXXIV. *Anticipated Curtailment of Timber Supplies from Sweden.* By Lieut.-Colonel BAILEY.

The correspondent of the *Times*, writing from Stockholm, makes the important announcement that on 27th April, after prolonged debates in both Houses, the Swedish Government passed a Bill limiting the rights of large timber companies to purchase extensive tracts of land in the forest districts of Northern Sweden. Under the old conditions, the timber on such lands was felled on a very large scale, more with a view to immediate profits than to the proper working of the forest lands, and the extension of agriculture in those districts was thus materially hindered. In defending the Bill, the Prime Minister said that the restrictions it established in the private rights of landowners as to the free disposal of their property constituted a legal consecration of the principle that such rights could not be considered as absolute and unlimited, but must give way to the necessity of safeguarding the future and the interests of the country at large.

This legislation will certainly tend to check the reckless destruction of growing forest in Northern Sweden, where private owners have, for a long time past, been disposing of their producing stock with a view to the "immediate profits" they have thus been able to realise. It must also, of course, tend to reduce the cuttings made in that country more nearly to the amount annually produced by the soil, and thus to bring nearer the time when our imports from Sweden, which at present consist largely of withdrawn wood-capital, will no longer be possible on the present scale. Whether this action by the Government comes in time to save a very large bulk of forest-capital remains to be seen; but be the diminished imports from Sweden due to simple exhaustion of capital, or to its better conservation, the immediate effect on us will be that either we must look elsewhere for a part of the supplies hitherto obtained from Sweden, or we must go without them. That this is a very serious consideration is proved by the fact that nearly one-quarter of our total annual imports now come from Sweden, which is also our largest source of supply. The amount annually received from that country is not far short of two and a half millions of tons.

If the Swedish Government could apply efficient restrictions to the working of the whole wooded area of the kingdom, it would thereby secure a constant output, which might be treated as a permanent minimum. But such outturn would certainly prove to be far smaller in amount than that which is now being cut; and the oft-predicted shortage of timber available for our daily requirements is appreciably nearer at hand than it was before this Bill was passed.

XXXV. *The Novar System of Combating Larch Disease.*[1]

Over the whole of Scotland and a great part of England and eland, profitable forestry may be said to be regarded as separable from the successful growth of the common larch. ut, unfortunately, in many districts this tree has, of recent years, oved so susceptible to the attack of a fungal disease that it ın no longer be depended on to give a full crop of timber, ıd resort has been had to several sylvicultural systems with a ew to preventing or mitigating the trouble. The practice that ıs been most generally recommended is to mix the larches with ıme dense-crowned species (spruce, silver fir, Douglas fir, or ech), the intention being to surround each individual larch ith other species immune to disease, so that should the parasite ppear on any particular tree, the chances of the spores spread- ıg to other trees of the same species would be reduced to a ınimum. Incidentally, this system possesses the additional dvantage of associating the larch—a thin-crowned, light- emanding tree—with other species having dense foliage. As consequence the ground is more completely shaded, weeds ıd ground vegetation are suppressed, and the area is furnished th a thick covering of dead leaves (forest humus), which atly improves the conditions of growth for the larch. Un- ıbtedly such a system of management has proved an advant- to the larch, but it has not in all cases sufficed to protect tree against disease. Moreover, it is evident that if each is to be effectively isolated in this way, only a comparatively number of plants of this species can be accommodated ı acre, and if the local demand for the other species is sfactory, the financial result of the system as a whole may much to be desired. Such a system of mixing, too, tends oduction of coarse timber by the shade-bearing species, lower branches are not killed sufficiently early under the ıde of the larch.

isfied on the whole with the results of even-aged mixing ch with other species, Mr Munro Ferguson, of Novar, ome years practised a system in his extensive woods in

[1] ced from the *Journal of the Board of Agriculture* for March 1906, ı of the Controller of His Majesty's Stationery Office.

Ross-shire which promises to provide a satisfactory solution of the difficulty. He now plants pure larch woods, and when the trees are sixteen to twenty years old he removes all the stems except the soundest and most promising, of which 300 to 500 are left per acre. Needless to say, the system is inapplicable to cases where all, or practically all, the trees are attacked by disease at this early stage, but instances of such virulence are, on the whole, of rare occurrence. The trees that are retained are the picked stems of the three to four thousand originally occupying the ground, and measure up to 51 feet in height and 4 to 8 inches in diameter at breast-height. Stems that are sound, or fairly sound, at this stage are not likely to suffer much from disease in later life. The thinnings removed realise £20 to £25 per acre, giving a return therefor of fully £1 per acre per annum from the time of planting. The thinning is done as early in autumn or winter as possible, and the next step is to knock off all the lower dead branches of the trees that are retained. This is a rapid process, and is accomplished by means of a pole some 8 feet long. The "top and lop" of the felled larches, along with the dead branches cleared off the standing stems, are then thrown together into small heaps and burned.

Owing to the shading of the dense crop of larch the surface of the ground is clear of all grass and similar vegetation, and is in a very suitable condition for the reception of fresh plants. Without loss of time the area is stocked with an underwood which, of course, must consist of species that can endure the shade of the 300 to 500 larches that have been retained. Mr Munro Ferguson at first used the Norway spruce, silver fir, and beech, but was not satisfied with the results obtained with any of these. The Norway spruce was found to grow very slowly under the circumstances indicated, while the silver fir in this particular locality is so much attacked by aphis (*Chermes abietis*) as to be very uncertain in its growth. Better results were obtained with the beech, and although this tree is now superseded by other species, it will probably be found to be the most suitable for use on the chalk, and on calcareous soils generally. But for some years Mr Munro Ferguson has been experimenting with other shade-bearing trees, and has found that *Picea sitchensis* (*Abies Menziesii*), Douglas fir, *Tsuga Mertensiana*, *Thuya gigantea*, *Cupressus Lawsoniana*, and *Abies grandis* are far superior to the three species previously mentioned.

These he raises from seed in the home nursery and plants out, for the most part, as two-year seedlings—to some extent as three-year-old transplants—when they cost him but little more than the commoner forest trees. The surface of the ground being in fine friable condition, the underwood is introduced by dibbling, a wooden tool 2 feet in length and triangular in cross-section covered with sheet-iron being used for the purpose Working with this a man can easily plant 1000 trees in a day. The rate of growth of the species employed averages a foot to a foot and a half per annum, and in six to ten years the underwood or second story is practically covering the ground, with the crowns of the upper story of larch about 50 feet above. The intention is to repeat the thinning of the larch in about fifteen to twenty years from the time of the introduction of the underwood, when the number of larches left will vary from 100 to 200 per acre. At sixty to eighty years, depending on the locality, the state of the markets, and the condition of the crop, the larches will all be removed, when, if prices remain as at present, a return from them of £100 to £150 per acre may be expected. What the value of the underwood at this stage may be must remain a matter for conjecture, but even if it be inconsiderable, the financial results of the rotation cannot fail to be satisfactory. Needless to say, the system, as just described, cannot possibly be practised except in the absence of hares, rabbits, and deer, which at Novar, owing to unremitting attention, are practically non-existent.

The various items of cost per acre may be summarised as follows:—

	£	s.	d.
Burning the surface herbage preparatory to planting,	0	2	6
3500 two-year seedling larch, at 6s.,	1	1	0
Planting (dibbling or notching), at 3s. per 1000,	0	10	6
Beating up, say 500 larch, three years old, at 12s. per 1000,	0	6	0
Planting ditto, at 3s. per 1000,	0	1	6
Keeping down rank herbage in certain parts,	0	2	6
Total cost per acre of establishing the larch wood,	2	4	0
3000 two-year seedling Douglas firs or other species, at 10s.,	1	10	0
Planting by dibbling, at 3s. per 1000,	0	9	0
Beating up, say 200 three-year-old plants, at 15s.,	0	3	0
Planting ditto, at 3s. per 1000,	0	0	7
	£2	2	7

These items of cost doubtless seem very low to many planters, but on ground similar to that at Novar there is no reason why they should be exceeded. The soil is a light loam, which grows rather rank heather and grass, and if the spring is at all favourable the surface herbage is carefully burned off before the larches are planted. This enables small plants to be used, and permits of their insertion by dibbling or notching. There being no rabbits or hares, there is no expense for netting, while the cost of fences against stock is relatively a small item, the woodlands being in large enclosures.

[In connection with the above subject, see the "Scheme of Management of the Woods of the Novar Estate," published in the *Transactions* of the Society for the year 1899 (Vol. XVI. p. 25).—HON. ED.]

XXXVI. *Supply of Telegraph Poles to the Post Office.*

By Lieut.-Colonel F. BAILEY.

In his evidence before the Forestry Committee (1902), Mr Martin Roberts, Engineer-in-Chief to the Post Office, stated that the Post Office use red pine (*i.e.*, Scots pine or Scots fir) for their telegraph posts, and obtain their supplies from Sweden, Norway, Finland and other Russian provinces. The difficulty in obtaining the necessary supplies from these countries is increasing year by year, while the price of the timber is at the same time rising very rapidly; and Mr Roberts was recently sent abroad with a view to his opening up new sources of supply. The explanation of these conditions is that the longer and more suitable poles have been gradually cut out of the forests, and that the timber has now to be obtained from localities which are farther from the coast than those which previously yielded the supply. The Post Office invites tenders in this country, and allows any timber-merchant to quote for the required poles; but a very small proportion of them is bought here, and practically none of it is home-grown. Indeed, the specification now prescribes that the timber must be "Swedish, Norwegian, Finland, or Russian." The reasons for this are two, viz., that neither growers nor merchants of home-grown timber are prepared to tender for the yearly contracts, and that the quality of their timber is inferior to that of the timber obtained from abroad.

In the year 1892, the Postmaster General was urged to use native in preference to foreign Scots pine. He invited tenders, and a trial order for fifty poles was placed in January 1893; but only nine of the fifty poles supplied were found suitable for the purposes of his Department, the remainder being rejected as warped, knotty and unduly heavy (in consequence, no doubt, of their having been too recently cut). Several further attempts were subsequently made to obtain telegraph poles grown in this country, but always with the same result. In 1885, comparative strength-tests were applied to home-grown and to foreign poles, when it was proved that the former were greatly inferior to the latter, probably owing to their knotty and unequal texture. In conclusion of his remarks, Mr Roberts says: "I think, however, from the question of strength of the timber, that it does not appear probable that long, straight Scots fir poles, such as from 40 to 75 feet in length, are obtainable (in Britain);

and from the poles supplied under the trial orders, it would appear that, even with the shorter lengths, much difficulty would be experienced in getting shapely poles."

The above opinion will not cause surprise to those acquainted with our past sylvicultural errors, and with the still existing want of system in our timber-growing business. Crops of "shapely poles" which could be clear-felled, and the bulk of which could be handed over to the Post Office, were for the most part non-existent; and no doubt woods were searched through to find here and there, among the already too scanty stock, a pole that might comply with the Post Office specification. It is also more than probable that most of the poles so found and cut, being the most "shapely" of the crop, were precisely those the retention of which sylvicultural considerations called for. But even so, the quality of the bulk of these poles was far below standard, and the expense of cutting and collecting them from a large area must have been excessive; while the practice of pecking at a crop and removing from time to time the finest poles as they become saleable cannot be too strongly condemned, resulting as it does in a ragged, worthless crop of trees, for which, during the whole course of their lives, no purchaser has been found. Such a "final" crop cumbers the ground, as it yields no adequate "increment" per acre, and what it does yield is of inferior quality.

As the Post Office purchase annually a considerable quantity of telegraph poles, it is a matter of importance to proprietors and wood-merchants that we should secure this market for our produce; and there is absolutely no reason why this should not be done if proprietors would grow Scots pine trees with tall, straight and clean stems, underplanting them with shade-bearers at a suitable stage of their growth. If crops were thus grown, and if the woods were organised so as to provide a steady annual yield of poles of constant size and quality, the market would be captured at once. In the absence of such organisation, we cannot be surprised that, as Mr Robert says, neither growers nor merchants of home-grown timber are prepared to tender for the Post Office yearly contracts. They have no certain knowledge as to what they can put upon the market from year to year.

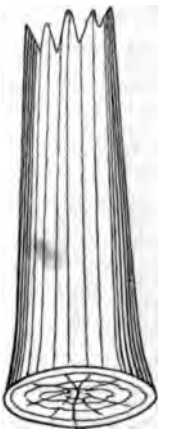
If further information on this subject, or in regard to the requirements of the Post Office in oak timber, be desired, reference may be made to pp. 135, 136, and to Appendix XVII.,

p. 187, of the Minutes of Evidence given before the Forestry Committee of 1902.

The current Post Office specification for foreign poles is appended.

Specification of Telegraph Poles.

Description.—Swedish, Norwegian, Finland, or Russian red fir (*Pinus sylvestris*), sound, hard-grown (*i.e.*, well-hearted, and with the annular rings closely pitched), straight, free from large or dead knots, especially knots forming a complete ring, and from other defects, and to have the outer and under bark completely removed.



To have been felled when the sap is down, and in no case earlier than the 1st of November 190 or later than the 1st of March 190 .

Each pole to contain the natural butt of the tree, *i.e.*, to be sawn off as close to the ground as possible, and no timber whatever to be removed at the butt end, or trimmed or cut away from the butt end, so as to reduce its natural size, but this end to be sawn to give a flat section, as shown in the adjoining sketch.

Dimensions to be in accordance with the subjoined Table.

Mode of Delivery.—All poles to be delivered carriage free, either—

(*a*) Upon the wharf of the Creosoters; or

(*b*) Upon some other wharf, if so directed by the Postmaster General; or

(*c*) Into lighters provided by the Creosoters, if it be impossible for the vessel to come alongside their wharf; or

(*d*) Into railway trucks provided by the Creosoters at the place of delivery, if the creosoting works are not accessible by water carriage; or

(*e*) Into waggons or timber carriages provided by the Creosoters at the place of delivery.

NOTE.—*The cost of delivery as above may be taken as approximately equivalent to an addition of one shilling and threepence per load on c.i.f. terms, except in London, where two-thirds of the cost is borne by the Creosoter.*

If the poles have to be floated or immersed in water after

leaving the vessel in which they are imported, they shall not remain so immersed longer than seven days.

Sizes of **Light** Poles.				Sizes of **Medium** Poles.				Sizes of **Stout** Poles.			
Length.	Diameter at Top.		Minimum Diameter at 5 Feet from Butt End.	Length.	Diameter at Top.		Minimum Diameter at 5 Feet from Butt End.	Length.	Diameter at Top.		Minimum Diameter at 5 Feet from Butt End.
	Minimum.	Maximum.			Minimum.	Maximum.			Minimum.	Maximum.	
Ft.	Ins.	Ins.	Ins.	Ft.	Ins.	Ins.	Ins.	Ft.	Ins.	Ins.	Ins.
18	5	5⅜	6	18	5½	6½	7¼	18	...	..	...
20	5	5⅜	6	20	5½	6½	7½	20	...	...	...
22	5	5¼	6¼	22	5½	6⅝	7⅜	22	...	...	...
24	5	5⅜	6½	24	5½	6⅝	8	24	...	...	...
26	5	6	6⅝	26	5⅝	7	8¼	26	7½	9	10¼
28	5	6	7	28	5⅝	7	8½	28	7½	9½	10½
30	5	6	7¼	30	6	7¼	8⅝	30	7½	9½	10⅝
32	5	6¼	7¼	32	6	7¼	9	32	7½	9⅝	11
34	5	6¼	7½	34	6	7½	9¼	34	7½	9⅝	11¼
36	5	6½	7⅝	36	6	7½	9½	36	7½	9¾	11½
40	5	6½	8	40	6	7½	9⅝	40	7½	9⅝	12
45	5¼	6⅝	8⅜	45	6½	8	10⅜	45	7⅝	10	13
50	5¼	7	9½	50	6½	8¼	11½	50	7⅝	10¼	13⅜
55	5½	7⅛	10¼	55	7	8⅜	12½	55	8	10½	14⅜
60	5½	7¼	11	60	7	8⅜	13¼	60	8	10½	15½
65	6	8	12	65	7	9	14	65	8	10½	16¼
70	6½	8½	13	70	7	9¼	14⅜	70	8	10½	17
75	6⅜	8⅜	13½	75	7	9½	15½	75	8	10½	17⅜
80	...	...	...	80	7	9½	16¼	80	8	10½	18⅜
85	...	...	...	85	7	9⅜	17½	85	8	10½	20

The average number of poles of each class purchased by the Post Office in the years 1904 and 1905 has been as follows:—

Length in Feet.	Light.	Medium.	Stout.	Total.
24	3250	1500	...	4,750
26	3000	1000	...	4,000
28	1250	2750	...	4,000
30	400	2500	3,000	5,900
32	200	750	2,750	3,700
34	70	225	3,000	3,295
36	175	250	7,000	7,425
40	187	475	4,250	4,912
45	25	300	1,250	1,575
50	25	150	600	775
55	...	50	300	350
60	...	25	185	210
65	...	...	112	112
70	...	5	35	40
Totals, . .	8582	9980	22,482	41,044

XXXVII. *Area of Woodlands in Great Britain.*[1]

In connection with the Agricultural Returns of the present year, special inquiries were made with the view of ascertaining the extent of land now occupied by woods in Great Britain, in pursuance of a recommendation by the recent Departmental Committee on British Forestry that a return should be obtained by the Board in continuation of that in 1895. The difficulties of securing an exhaustive return of all land under wood have been pointed out in commenting on the previous returns of this nature, but it is believed that the special pains taken by the officers of Inland Revenue in the distribution and collection of the schedules have resulted in rendering the present return substantially accurate. It is to be observed, however, that in some instances the inclusion of woodland areas, which were formerly overlooked, may tend to vitiate comparisons with previous figures for particular counties or districts, and may account to some extent for apparent increases in the areas returned.[2]

The woodland area is now returned under the several categories of (1) Coppice, *i.e.*, woods, whether containing standards or not, that are entirely cut over periodically and reproduce themselves naturally by stool-shoots; (2) Plantations, *i.e.*, land planted or replanted within the last ten years; and (3) "Other Woods," which include all land (not returned as coppice or plantation) used altogether or mainly for the growth of wood (other than orchards).

Summarising the new returns geographically in the groups of counties usually adopted for the purposes of the Agricultural Returns, the woodland acreage of 1905 was distributed as follows:—

[1] Reproduced from the *Journal of the Board of Agriculture* for December 1905, by permission of the Controller of His Majesty's Stationery Office.

[2] The figures are given for each County in the Agricultural Returns (Acreage and Live Stock), 1905. Price 6d.

Divisions.	Coppice.	Plantations (since 1895).	Other Woods.	Total Woodlands.
	Acres.	Acres.	Acres.	Acres.
I. Eastern and North-Eastern,	47,159	11,297	189,038	247,494
II. South-Eastern and East Midland, . . .	270,683	15,580	318,303	604,566
III. West Midland and South-Western, . . .	184,618	16,156	268,815	469,589
IV. Northern and North-Western, . . .	35,663	16,614	341,547	393,824
ENGLAND, . . .	538,123	59,647	1,117,703	1,715,473
V. WALES, ...	15,733	8,629	159,999	184,361
VI. SCOTLAND (Eastern), .	8,645	22,768	421,489	452,902
VII. SCOTLAND (Western), .	14,370	12,639	388,498	415,507
GREAT BRITAIN, .	576,871	103,683	2,087,689	2,768,243

The present total area thus shown in Great Britain, 2,768,243 acres, is 42,127 acres in excess of that returned ten years ago. This extension was, however, confined to England and Wales, the total area of woods in Scotland showing a decline of 10,356 acres. The decrease north of the Tweed has occurred notwithstanding the fact that 35,407 acres of land are returned as having been planted or replanted during the past ten years, so that it would appear that the clearance of woodland areas by storms and from other causes has been considerably greater than the owners of land have been able to make good.

Some indication of the extent of planting or replanting which has apparently taken place within the past twenty-four years may perhaps be given by comparing the returns of plantations collected for 1891, 1895, and 1905 respectively. The areas planted or replanted in the three periods for the agricultural divisions above referred to are given in the next Table.

It will be noted that whereas the earlier and later periods extended over ten years, the intermediate period embraced only four years. By dividing the figures in each case by the number of years represented, the apparent average annual rate of planting thus obtained may be considered to indicate approximately the relative amount of activity in woodland extension during each period. Subject to the caution already given as to the possibility of more complete returns, it would appear that planting was carried on in Great Britain, as a whole, during the

past decade at the rate of 10,368 acres per annum, as compared with 8225 acres during 1891-95 and 9894 acres during 1881-91.

Divisions.	1881 to 1891.	1891 to 1895.	1895 to 1905.
	Acres.	Acres.	Acres.
I. Eastern and North-Eastern, .	5,879	3,145	11,297
II. South-Eastern and East Midland,	12,481	4,176	15,580
III. West Midland and South-Western,	14,270	4,484	16,156
IV. Northern and North-Western, .	14,643	4,156	16,614
ENGLAND, ...	47,273	15,961	59,647
V. WALES, ...	11,120	2,533	8,629
VI. SCOTLAND (Eastern), . .	19,957	8,335	22,768
VII. SCOTLAND (Western), . .	20,590	6,074	12,639
GREAT BRITAIN, .	98,940	32,903	103,683

This tendency to reduced activity in the middle period, followed by greater activity after 1895, is suggested both in England (as a whole) and in Wales. In the Eastern Counties, as well as in the group of counties lying on the Welsh border, there is a suggestion of continuously progressive activity during the whole twenty-four years, but in all other parts of the country the general indication is in the direction just mentioned. In Scotland experience seems to have been more varied. In the Eastern and Lowland division the rate of planting has, on the whole, increased, whereas in the Western and Highland division it seems to have substantially diminished. This seems to be largely due to some exceptional activity in Inverness and Ross and Cromarty during the decade 1881-91.

XXXVIII. *The Society's Register of Foresters and other Estate-men.* By the SECRETARY.

The proposal that the Society should start a Register of Foresters was made at an early date in its history. As far back as 1866 a committee was appointed to consider the matter, and later, prizes were offered for essays on the subject. Two of these, one by Mr James Kay, forester, Bute, and the other by Mr C. Y. Michie, forester, Cullen, were published in Volume V. of the Society's *Transactions*, but no further action appears to have been taken at that time. The subject was again raised by the late Lord Mansfield in his Presidential Address, delivered before the Society on 31st January 1900, and a committee of the Council having reported in favour of the proposal, the Register was started in 1903.

Mr Kay's main proposal was that a Committee or Board of Examiners should be appointed by the Society for interrogating intending foresters, and that a Register should be kept of such as should pass an examination in stated subjects connected with forestry. He proposed to divide the candidates into—1st Class, who had obtained excellent results; 2nd Class, who had obtained good results; and 3rd Class, who were only qualified as assistant foresters. The salaries he proposed to attach to these classes were—1st Class, from £80 to £100; and 2nd Class, £60. He did not state a salary for those in the 3rd Class. He also advocated that a text-book should be provided dealing with the subjects of examination.

Mr Michie also recommended that a committee of the Society should be appointed to interview candidates. He did not, however, prescribe subjects for examination, his object being merely to interrogate the men as to their experience, etc. He also proposed to divide the men into four classes, the salaries suggested being £100, £80, £50, and £40.

It will be observed that, according to both of these schemes an attempt would have been made to select the candidates with a view to admission to the Register, and to classify them in the Register according to their merits.

The committee appointed in 1902 did not think it necessary in the early stages of the Register, that candidates should be examined and classified. They contented themselves with

reporting that "a list of Members desirous of obtaining situations should be kept by the Society, but that in the meantime a formal Register was unnecessary." They laid down the following conditions:—

1. No name will be placed on the Register until a Schedule of Particulars, to be provided by the Society, has been filled up and signed by the Applicant, and sent to the Secretary along with a fee of One Shilling.
2. The Society will merely introduce Applicants for situations to Employers who ask the Society's assistance, and will undertake no further responsibility in the matter.
3. Applicants must inform the Secretary as soon as they are engaged, so that their names may be removed from the Register.
4. Employers will be charged a fee of Two Shillings and Sixpence for each introduction which results in an engagement.

The Schedule of Particulars referred to is as follows:—

SCHEDULE OF PARTICULARS.

Name in full.
Address.
Age.
Parish and County, Native of.
Where Educated, and Educational Attainments.
Married or Single.
Number of Family at Home.
Kind of Situation wanted.
Wages expected.
References—how long in each place, and in what capacity.
Name of present or last Employer.
Special Training received, or Special Work done.
Classes or Lectures attended, and results gained at Examinations.
Books on Forestry or other Estate Work, studied.

Appended to the Schedule are two blank pages for copies of testimonials, and in the event of that space being insufficient, applicants can insert more sheets.

With such particulars before him, an employer can at once determine which men are likely to suit him, and regarding whom

he requires further information as to character, etc., before finally making his selection.

Since the Register was instituted in 1903, 56 names have been sent in. Of these, 24 have been removed from the Register, but not all of these have received appointments through the Register. There are still 32 names on the list, and these may be described as follows:—

3 Overseers,
8 Foresters or Overseers,
15 Foresters,
3 Foreman Foresters,
1 Forester or Saw-miller,
1 Assistant Forester, and
1 Clerk of Works.

At first it was proposed that the Register should be open to Members of the Society only, but latterly the Council agreed that it should be open to non-Members also.

It will be seen that although a considerable number of men have sent in their names, only a small proportion of them have secured situations. The Register has been advertised in each number of the *Transactions* and in the Society's circulars, but proprietors have not yet taken advantage of it to the extent expected. Most of the applications from proprietors have been for men in the lower grades, whereas most of the candidates for situations have been men fully qualified for more responsible positions, but for whom, unfortunately, there has been little demand as yet through the Register.

The Council take this opportunity of appealing to proprietors to make more use of the Society's Register when in need of estate-men; and they invite foresters and others desirous of employment or promotion to send in their names to the Secretary, from whom Schedules and other particulars may be obtained.

NOTES AND QUERIES.

Appeal for Contributions.
By the Honorary Editor.

ɔehalf of the Committee, the Honorary Editor appeals to ɛmbers of the Society for their support to the newly rated half-yearly issues of the *Transactions*. If pro- ɜ, factors and foresters would contribute to our pages he vast store of practical knowledge they have acquired, blication would at once assume a highly increased value terest. We have given our readers, from time to time, ɨ by the highest authorities on general questions of policy ractice; and of such articles a sufficiency will, without continue to become available. But of communications ıng the application of acknowledged principles under the ons here prevailing we have hitherto seen far too little. s and their professional assistants come and go, without ɾ behind them, for the guidance of their successors, any ɔf the invaluable experiences they have accumulated. ' would, from time to time, give us the benefit of these ɛnces, pointing out by what means, and with what measure cess, difficulties were combated, our *Transactions* would ɔrm the basis of a Manual of Scottish Forestry of unique

subjects on which communications would be welcome are rless, but a few of them may be mentioned by way of tion:—

ature of localities found here to be most suitable for forest crops of various species, including exotics.

ɔecies, including exotics, found here to be most suitable as forest crops in localities which are unfavourable from various causes, such as high elevation, exposure to cold or strong wind, frost, bog, etc.

heap and successful methods of planting.

ıccessful "direct" sowings.

ıccessful natural regeneration.

ıccessful treatment of crops up to middle age, especially with regard to mixed crops.

Successful under-planting of crops of light-crowned species.
Successful protection of nurseries and forest crops from injury by animals, birds, insects, fungi, weeds, smoke or meteoric phenomena (such as frost, wind, snow, etc.).
Successful use of mechanical appliances for the moving of timber.
Cheap and successful methods of increasing the durability of timber.
Cheap and successful methods of converting and seasoning timber.
Utilisation of waste wood (slabs, tops and branches, etc.).

But of course there are many other subjects.

The communications asked for need not take the form of lengthy articles, such, indeed, not being required. The Honorary Editor will welcome brief statements of well-authenticated facts, with sufficient particulars to render them intelligible and instructive; and he trusts that lack of literary experience and skill will not deter any one possessed of valuable knowledge of the kind indicated from writing to the *Transactions* in regard thereto. F. B.

Diploma in Forestry at Oxford.

The Secretary of State for India will nominate annually a number of probationers (about ten every year) for service in the Indian Forest Department. Candidates must be over eighteen and under twenty-one years of age on January 1st of the year in which they are nominated. The nominations will be based upon the results of a competitive examination held, usually in the month of August of each year, by the Civil Service Commissioners. Candidates must have passed "Responsions" or an equivalent examination. The subjects of the competitive examination are—

1. Mechanics and Physics
2. Chemistry
3. Botany

} Approximately according to the standard of the Preliminary Examination in the Honour School of Natural Science at Oxford.

Candidates must also pass a qualifying examination in German. Detailed conditions of admission may be obtained from the Secretary, Judicial and Public Department, India Office, Whitehall, London, S.W.

The probationers for the Indian Forest Service must go

through the course of instruction detailed below, and must obtain the Diploma in Forestry within the period of three years assigned to that course. They will then, if of sound constitution and free from physical defects which would render them unsuitable for employment in the Indian Forest Service, be appointed Assistant Conservators in the Indian Forest Department.

Occasionally, probationers are nominated for service in the colonies, under conditions similar to those which apply to probationers for service in India.

The Diploma is granted to members of the University who have—

1. Pursued an approved course of study extending over two years at Oxford.
2. Undergone a course of practical work at places and under conditions approved.
3. Satisfied the examiners in prescribed examinations.

The course of study at the University, which commences in October of each year, comprises the following subjects:—

During the First Year.

(*a*) Mathematics; (*b*) Chemistry of Soils and selected chapters of Organic Chemistry; (*c*) Geology; (*d*) Botany; (*e*) Forestry, comprising Sylviculture, and either Protection or Utilisation; (*f*) Geometrical Drawing and Elementary Forest Engineering; (*g*) German.

The course includes practical work in the Forest Garden, and excursions in Term and in the Vacations, including a three weeks' tour in French forests. Students must meet the expenses of these excursions.

During the Second Year.

(*g*) German; (*h*) Geology of India; (*k*) Botany, comprising Pathology, the Structure of Timber, and Special Systematic Botany; (*l*) Entomology; (*m*) Forestry, comprising Forest Management, Forest Administration, and either Utilisation or Protection; (*n*) Forest Law; (*o*) Surveying; (*p*) Book-keeping in relation to Indian Forest Accounts.

The Third Year

is occupied by a nine months' practical course in German State forests. It extends over the period from the beginning of

October to the beginning of the following July. For about seven months of this time the students are placed for instruction under selected German forest officers. During the remaining time they visit other forest districts. To qualify for this course they must have passed the First Examination for the Diploma, and must possess a sufficient knowledge of the German language.

Students admitted to the course will be required to pay, in three instalments, a sum of £180, for which there will be provided board and lodging, travelling expenses, and fees to local forest officers. There are two examinations (partly written and partly practical) for the Diploma. They are held about September 20th in each year, and the fee for each of them is £2.

Mr James Gunn, from the University of Edinburgh, joined the Oxford School of Forestry in October, as a candidate for the Indian Forest Service. F. B.

South African School of Forestry.

The South African School of Forestry is being established by the Government of Cape Colony for the scientific training of forest officers, and for research in South African forestry. The aim of the school is to provide a thorough course of instruction in forestry, with special reference to South African conditions. Provision is being made at Tokai for ten resident students, five of whom will be candidates for two vacancies in the supervising grade of Cape forest officers, and accommodation will be reserved for five students to be nominated by the Governments of both South African colonies.

The science departments of the South African College will be used for the theoretical work of the School of Forestry, the College departments of botany, chemistry, engineering, mineralogy, geology and physics being well equipped with lecture-rooms and laboratories. A reading-room and a reference forest library will be provided for students at Tokai. The herbarium at the Conservator's office, and the forest timber collections both at the Conservator's office and at Tokai will be available for purposes of instruction.

The Tokai arboretum, which now comprises the largest collection of timber-trees in South Africa, affords unique

tunities for practical instruction in sylviculture. To this will be added the pineries and sand-reclamation planting in the Cape Flats, together with the fine arboreta and forests at Ceres Road, comprising forest estates of 20,000 acres Such instruments as are required for practical forest work, including plane-tables, barometers, chains, dendrometers and calipers will be provided.

Arrangements will be made for granting certificates or diplomas to students who have satisfactorily completed the course in forestry. Applications for further information and for admission to the School of Forestry should be addressed either to the Chief Conservator of Forests or to the Registrar, South African College, Cape Town.

We cordially welcome this indication of progress, and wish the young institution every success in its endeavour to train men for the important task of developing the enormous possibilities which unquestionably exist in South African forests.

F. B.

Sir Herbert Maxwell on Neglected Woodlands.

On March the 22nd, at the Carpenters' Hall, London Wall, Sir H. Maxwell, F.R.S., delivered an interesting address to a crowded audience on "The Neglected Resources of our British Woodlands." The chair was occupied by Lord Leconfield. Sir Herbert Maxwell, in the course of his address, said it was generally recognised, even in this country, that the resources of our woodlands had been seriously neglected in the past, and were capable of development, slow he was afraid, if once they were put on a sound system of management. The economic importance and increasing urgency of the question, in view of the rapid diminution of the world's visible timber-supply and the simultaneous increase of consumption, had occupied the attention of all European Governments. What were we doing in England to meet the coming scarcity? He was sorry to say that we had not yet got beyond the stage of inquiry. Forestry operations were naturally slow, but to allow a quarter of a century to be occupied in inquiry was far too long. He entered Parliament in 1880; he left it, voluntarily he might say, this year. In that time two Committees, one Select and one Departmental, had

been appointed to inquire into the matter. They had inquired, but beyond that nothing had been done. Both Committees had reported that large tracts of waste land were available for the purpose, but no steps had been taken in the matter. Instead, the Reports of the Committees had been carefully pigeon-holed. Time was slipping by, and nothing had been done. All that had been done was to nibble at what was a great question. Nothing could be more groundless than the complaints as to the British soil being against the proper growth of timber. In one case it was shown that the Douglas fir could be properly and profitably grown, but its capabilities had not yet been fairly tested in this country. He pointed out that the State forests in Germany were worked at a handsome profit to the revenue, whereas in England the returns of the Commissioners of Woods and Forests showed a loss. He said he was not throwing any reflection on the Department. It worked under rigid restrictions, and it was those who were responsible for the restrictions that should be held to account for allowing the natural resources of the country to remain undeveloped.—*Scotsman.*

A Tree-Strangling Fungus.[1]

This fungus (*Thelephora laciniata*) has long been known as destructive pest to young trees of various kinds. Quite recent some hundreds of ash saplings were killed by it. The fung is not a parasite; that is, it does not penetrate the tissues of t plant it attacks, but causes death by strangulation. The fung is most abundant on sandy heaths, where it forms large patch of a dark brown colour on the ground; these patches consist several overlapping thin plates with irregularly toothed margi When it happens to be growing near to a plant of heathe ling, it grows up round the stem, to which it adheres very clos giving off from time to time a loose frill as it ascends. extends up the stem for a distance of six inches to a fo more, and in course of time kills the stem it has encircled.

Young conifers planted in such situations often suffer sev it being no uncommon sight to see almost every tree enc

[1] Reproduced from the *Journal of the Board of Agriculture* for I 1906, by permission of the Controller of His Majesty's Stationery Offi

by the fungus, and small examples are often entirely enveloped in its folds.

In nurseries where the ground is carefully cultivated the

ASH SAPLING STRANGLED BY *THELEPHORA*.

fungus does not gain a foothold, and when trees are planted in localities where the fungus abounds, if the soil round the stem is broken up once a year all danger will be avoided.

A Conifer Disease.[1]

Quite recently a batch of diseased spruce seedlings was sent to the Royal Botanic Gardens, Kew, from upland Yorkshire, accompanied by a statement that the disease was most prevalent at the crowded end of the seed-bed; the portion where the plants were not so crowded appeared to be fairly free from it. Examination showed the disease to be caused by a fungus called *Herpotrichia nigra* by Hartig, who recorded it as an injurious parasite in the spruce woods of the Bavarian Forest.

The leaves are attacked and killed by the fungus, but instead of falling when dead they are bound together by mycelium, and remain as a compact brown mass clustered round the branch from which they sprang. These dense clusters of dead leaves, fixed to the branches by dark-coloured cob-web like mycelium, are very characteristic. The fruit of the fungus and also minute sclerotia are produced on the leaves.

The parasite is most prevalent in nurseries at high elevations, and has been recorded as attacking spruce (*Picea excelsa*), mountain pine (*Pinus montana*), and juniper (*Juniperus communis*). It occurs in Germany and Norway. It does not appear to have been previously recorded in Great Britain.

The following observations with a view to its prevention are made by Hartig:[2]—"It is an interesting biological point that the fungus grows, especially when the temperature is low, under the snow or during the time it is melting, because under such circumstances the air is completely saturated with moisture. The frequency of the disease at high elevations has led to the general adoption of the practice of forming spruce nurseries at low altitudes. It has also been found a good plan to look over the nurseries immediately after the melting of the snow, and to raise up all prostrated plants in order that they may be exposed to the wind. It would also be a step in the right direction in planting out trees to set them on hillocks and similar elevations, and to avoid placing them in hollows and other depressions."

It is important that diseased seedlings should be collected and destroyed by burning, otherwise the numerous fruits and sclerotia

[1] Reproduced from the *Journal of the Board of Agriculture* for June 1905, by permission of the Controller of His Majesty's Stationery Office.

[2] *Text-Book of Diseases of Trees* (Hartig and Somerville, English ed., p. 76).

present on the leaves would prove a source of danger in the future.

SEEDLINGS OF SPRUCE ATTACKED BY *HERPOTRICHIA NIGRA*.

Forestry in Kiao-chau.

According to the *Cologne Gazette*, the policy of the German Government in promoting forestry in Kiao-chau is already bearing satisfactory fruit. Every year the area of afforestation grows larger, and the Chinese, stimulated by German example, are said to be planting trees on their own account, and to be awake to their value as wind-breaks. It is further announced that the German forestry department of Kiao-chau is to be strengthened by an inspector of forests, who will start for the Far East in May.

Alcohol from Sawdust.

About 2 tons of sawdust are boiled with sulphuric acid for three hours, the liquid matter being then extracted by pressure, neutralised, left to stand for eighteen hours to cool and clarify, and then fermented for four or five days. The resulting alcohol is afterwards distilled and rectified; and, making ample allowance for loss in the latter operation, the yield of spirit is said to be about 2½ quarts per cwt. of sawdust. Trials made with the method on a manufacturing scale are claimed to have demonstrated the possibility of working at a profit, and of opening up a new industry in timber-producing countries, where enormous quantities of sawdust are annually wasted.—*Country Brewers' Gazette.*

Note on Review of *The Forester*.

In the kindly and generous criticism given to *The Forester* in Vol. XIX. Part I., I should like to correct an error on p. 228, in the passage which says that—

"The author nullifies a great deal of what he has previously said when he practically admits that 'trees grown in our more open woods . . . are, although shorter in the bole and rougher in the top, more durable, of greater density and greater strength than timber grown closely together, as it is in the well-managed Continental and in the primeval virgin forests,' a fact, at least so far as the timber of broad-leaved trees is concerned, which is apt to be lost sight of in these days of advocacy of wholesale adoption of Continental methods."

The opinions above expressed within the quotation marks are not the author's, but are those of Mr Margerison, as contained in a written statement handed in to the Departmental Committee on Forestry, 1902. The original quotation in *The Forester* continues from near the foot of p. 451 to far down on p. 45 of vol. ii., where the acknowledgment concerning Mr Margerison is made in full. The author's personal opinions about this matter are given on pp. 442 and 443. J. N.

Aberdeen Branch of the Society.

On the 18th May 1906 a Branch of the Royal Scottish Arboricultural Society for the Counties of Aberdeen, Banff, and Kincardine was formed at Aberdeen. A detailed report of the inauguration of the Branch will appear in the *Proceedings* of the Society in due course.

REVIEWS AND NOTICES OF BOOKS.

Fremdländische Wald-und-Parkbäume für Europa. By HEINRICH MAYR, Dr. philos. et oec. publ., o. ö. Professor der forstlichen Produktionslehre an der k. Universität zu München.

This important work runs into over 600 pages, and contains 258 illustrations in the text, to which are added 20 plates, made up of 354 illustrations, many of which are beautifully coloured. From the above it will be gathered that the book contains a vast amount of information, and what is more important is that this information has been collected at first hand by the author in his world-wide travels. Prof. Mayr has been round the world no less than three times, visiting the forests in every continent and in every region. He has therefore had the opportunity of thoroughly studying in their native habitats the trees with which he deals, and can speak with great authority regarding their characteristics from a botanical, sylvicultural, or arboricultural standpoint. He has, further, spared no pains to record every fact and to give every detail concerning the species which may be cultivated for use or ornament in Europe.

A most interesting and striking feature of the book is the masterly way in which the author deals with the natural distribution of trees and forests. He has collected from personal observation, and from every possible source, all the available data concerning the climate in which the trees find themselves at home. The past meteorological records, combined with the author's careful study of the indigenous Flora, as well as the horticultural and agricultural plants cultivated in the various regions and climates, form the basis upon which he has mapped out the distribution of the different species of forest trees. The zones of forest vegetation are indicated according to latitude and altitude.

In the first section of the book, the natural distribution of the exotic forest and park trees is thus dealt with in a manner so scientific and practical that one need never be at a loss to know how the exotics are likely to behave when introduced into similar climates in Europe. In addition to all this, Prof. Mayr

is able to give the results of his own extensive experiments in the cultivation of many of those exotic trees.

In the second section is included a most valuable table dealing with the forest zones, which exhibit similar climatic conditions in North America, Europe, and Asia. Altogether, the author distinguishes six principal zones based on similarity of climate and forest Flora, viz.:—

(*A*) Tropical Forest Zone - The Palmetum.

(*B*) Sub-Tropical Forest Zone of the Evergreen Oak and Laurel Tree—The Lauretum.

(*Ca*) Temperate Warm Zone of the Deciduous Forest, Warmer half—The Castanetum.

(*Cb*) Temperate Warm Zone of the Deciduous Forest, Cooler half—The Fagetum.

(*D*) Temperate Cool Region of the Spruce, Silver Fir, and Larch—The Picetum or the Abietum or the Laricetum.

(*E*) Cold Region of the Scrubwood or Dwarf Trees, Forest Limit—The Alpinetum or Polaretum.

All of the above zones, except A, are represented in Europe.

We strongly recommend a careful study of this and the other sections by all those who are interested in the cultivation of trees—indigenous or exotic—for profit or ornament. There is no other source from which so much important and valuable information can be obtained.

The third section consists of a most lucid and intensely interesting dissertation concerning the capability of exotic trees for cultivation in Europe. This is treated under three headings, viz., Acclimatisation, Naturalisation, and the Locality from which the seed comes. These are questions which, naturally, are of the greatest interest to British foresters. It will be readily admitted on all hands that opinions regarding these various problems are not at all uniform, and those who are interested in these matters could not do better than turn to this work, where they will find the subject dealt with from its foundation.

Space forbids our entering into detail, but there are other eight sections or chapters likewise replete with information and illustrations regarding exotic trees. Their distribution, nomenclature, recognition, cultivation, and uses,—in fact everything, so far as is at present known about their botanical, sylvicultural and arboricultural characteristics, has been given by the author

in a most readable and interesting fashion. This and the wealth of illustrations which accompany the text make the work one which far surpasses anything else of its kind at present in existence.

The Index is in the form of a register, which must have cost an enormous amount of labour in its compilation, and it has been framed in such a way that complete references regarding any one of the species mentioned in the book may be found with the greatest facility. A. W. B.

Künstliche Düngung im Forstlichen Betriebe. Von Dr Fr. Giersberg.

This excellent pamphlet has now reached the third edition. It was originally published in 1901, and the cordial reception with which it met called for a second edition in 1903. That edition was also rapidly sold out, and for some months back attempts to obtain a copy of the latest edition have met with the same reply—"Sold out." This is sufficient guarantee that Dr Giersberg's work is thoroughly sound, and that the subject is receiving very widespread attention.

Although the whole subject is one of comparatively recent date, it is surprising to find how much has been done in the way of experiment in various Continental countries. The success which attended the earlier experiments on the use of artificial manures in forestry has led to their more general adoption in the State forests, and also in communal and private forests in different countries.

The pamphlet is full of valuable information. A very important and interesting feature of the booklet is the great number of photographic records of experiments that are being carried on at different places. In many cases where the soil is of a very poor quality, the difference between the success or failure of the trees depends directly upon the use or non-use of artificial manures. Sometimes it may be even impossible to afforest certain tracts with timber-trees unless the soil is artificially enriched.

The author has put himself to no little trouble to collect as much information as possible concerning the effect of the various artificial manures on tree-growth. He also gives the opinions and experiences of a large number of highly-trained

foresters who can speak with great authority on such matters, and it may be added that the verdict of the best informed is all in favour of this artificial supply of food material for trees. The author gives evidence to show that artificial manures can be used with the greatest advantage in the nursery, both in the seed-beds and in the nursery lines. The advantages gained are a more vigorous and healthy development of the young trees from the first, in addition to their more rapid growth and greater certainty of success when planted out in the open.

Records of carefully collected statistics show that the extra initial expense involved is more than counterbalanced by what is saved in subsequent beating up or after-planting. Secondly, the author has shown that, under unfavourable local conditions, hitherto unused waste areas, as well as impoverished and exhausted land in general, may be more successfully and profitably utilised for afforestation when artificial manures are used. In proof of this statement, he cites results obtained especially in the sandy districts of Luxemburg, Holland and Belgium. A third question which the author has answered in a most satisfactory manner is that artificial manures can be used with the greatest advantage in the restocking of areas from which the mature trees have been removed.

Lastly, the fourth question which he has set himself to answer deals with the amelioration and improvement of meadow and other land; but the improved grazing and the increased head of deer is probably of more importance in Continental forests than in British woodlands.

In conclusion it may be added that Dr Giersberg has obtained from all over the Continent photographic records of experiments which show the great benefits of the treatment he advocates.

A. W. B.

OBITUARY NOTICE.

Death of the Earl of Mansfield, ex-President of the Society.

In common with the whole country our Society sustains a real, irreparable loss by Lord Mansfield's death. He was so unlike anyone else, so great and distinguished in character, so indifferent to current opinion, so hostile to clap-trap, that no one takes his place.

Scotland without Lord Mansfield is what Scone would be without the Tay, and he is to-day mourned by many both in private and in public life.

As a friend there was none like him. To have his friendship once was to have it unreservedly and for ever, through good report or evil, in fair weather or foul. He was an excellent judge of men and affairs, had clear insight, unremitting industry and genuine kindliness. Holding strong views and very definite principles, his course of action or line of reasoning was always peculiarly characteristic; his knowledge of history and literature, and extraordinary memory, combined with his natural gifts and keen appreciation of current movements, rendered him one of the soundest of men in public affairs. He recalled some figure of the eighteenth century; yet it would be hard to find anyone with such striking individuality even in Sir Walter Scott's great gallery of portraits. By natural instinct and through long association with his aged grandfather he belonged to the past, but his reverence for tradition never narrowed his view of the present, nor prejudiced his judgment on current events.

Whether as student or soldier, as a son or as the head of his house, in land management or in public service, he was always the same—simple, upright, original.

If no man had a stronger sense of the inherited responsibility of the ruling class, few came more readily into contact with men in every pursuit and condition of life, and we have had no Member of our Society better liked and respected. He was one of the first to secure the advantage of evening instruction for the younger foresters on his own estates, and not even his devotion

to sport could render him indifferent to the practical issues involved in scientific sylviculture.

No one who has known Lord Mansfield can forget or cease to regret him. Nor will those who came under his influence ever be without a sense of added strength, or cease to be stimulated by the recollection of the dauntless resolve with which he faced the duties and difficulties that confront every active and independent worker. Being true to himself made him true to others, and he leaves an example that is precious in days when simple, essential virtues are rare. R. M. F.

May 1906.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING.

PROCEEDINGS IN 1906.

THE ANNUAL MEETING.

The Fifty-third Annual Meeting of the Royal Scottish Arboricultural Society was held in the Goold Hall, 5 St Andrew Square, Edinburgh, on Friday, 2nd February 1906, at 2.30 P.M. Mr W. STEUART FOTHRINGHAM of Murthly, President of the Society, was in the Chair, and there was a good attendance of Members.

APOLOGIES FOR ABSENCE.

Apologies for absence were intimated from Mr R. C. Munro Ferguson, M.P., Honorary Secretary; Sir Kenneth Mackenzie; Colonel Bailey; Sir Archibald Buchan-Hepburn; Mr W. A. Rae, Murthly; Mr John D. Sutherland, Oban; Mr David W. Thomson, Edinburgh; and Mr R. V. Mather, Kelso.

MINUTES.

The Minutes of the General Meeting held in Glasgow on 5th July last were held as read and approved of.

Report by the Council.

The Report by the Council was then read by the Secretary, as follows:—

Membership.

In the course of the past year the Society has sustained considerable loss through the deaths of several prominent Members and the resignations and lapses of others. Amongst the deaths recorded are those of Mr Alexander Pitcaithley, Forester, Scone, one of the Vice-Presidents of the Society; Mr David P. Laird, Nurseryman, Pinkhill, a former Vice-President, and Convener of the Excursion Committee; Mr Robert Baxter, Forester, Dalkeith, and Mr Patrick Neill Fraser, Murrayfield, both former Councillors; Sir Henry Trotter of Mortonhall; Sir James Miller of Manderston; Mr J. Windsor Stuart, Factor, Bute; Mr John Newbigging, Nurseryman, Dumfries; and Mr Archibald Henderson, Forester, Tullamore, one of the oldest Members of the Society.

At last Annual Meeting the number on the Roll was reported to be 1072. Seventy-three have been added to the Membership in the course of the year, but 63 have been removed owing to the causes mentioned. The Membership at this date is therefore 1082, made up as follows:—

Honorary Members, . . .	20
Honorary Associate Members, .	7
Life Members, ...	276
Ordinary Members, . . .	779
Total, .	1082

Prizes.

The Syllabus, containing 27 subjects for Essays, was issued in January 1905 along with the notice calling the Annual Meeting. Seven Essays were received and submitted to the judges, and six of these obtained awards. The Medals awarded were—One No. 1 Silver Medal, four No. 2 Silver Medals, and one Bronze Medal. In addition to these Medals, the Council, on the recommendation of the *Transactions* Committee, awarded a No. 1 Silver Medal to Mr Fred Moon for his article on "A Chafer Infestation," which was published in last year's *Transactions*.

Donors.

The thanks of the Society are again due to Messrs W. H. Massie, David W. Thomson, and John Methven, for prizes

offered by them in the current year's Syllabus, and to the Directors of the Highland and Agricultural Society for renewing the vote of £20 for prizes for specimens of timber to be exhibited at the Forestry Exhibition in their Showyard at Peebles.

Transactions.

The Council thought it desirable to print off 1350 copies of the Jubilee Volume of the *Transactions*. Copies of the volume were presented to the Heads of the Forest School at Nancy, and the Heads of the Forest Departments which were visited by the Society in France in 1904; and a sufficient stock of this volume has been left in hand for future demands. It is proposed that a similar number of the *Transactions* now in preparation should be ordered. The Editors report that the part is well advanced, and they hope to have it in the hands of the Members in the beginning of March. In addition to one French and two German periodicals which have been bought for the use of the Honorary Editor, the Council have also decided to take in the *Indian Forester*.

Forestry Exhibition.

The Exhibition at Glasgow was not on such a large scale as the one held at Perth in the previous year, but it was still a very creditable undertaking. The Judges were—Messrs J. GRANT-THOMSON and JAMES KAY, Foresters, and Mr WILLIAM WILSON, Timber Merchant, Auchenleck. Their Report will be found printed in full in the Proceedings of the General Meeting which was held in the Showyard. From this Report it will be seen that they awarded ten prizes in cash and four Medals:—One No. 1 Silver Medal, one No. 2 Silver Medal, and two Bronze Medals.

Short lectures were delivered by Mr Leven on the "Creosoting of Timber," and by Dr Borthwick on "The Recognition of Forest Trees by Seed and Seedling," which were both well attended and much appreciated by those present. Mr Boyd, Pollok Estate, and Mr Whitton, Superintendent of City Parks, Glasgow, were kind enough to provide the necessary attendants. In addition to the Judges' Report, a full Report of the Exhibition will be found in the *Transactions*.

The Directors of the Highland Society have again intimated that they will be pleased to give facilities for holding the Exhibition in their Show at Peebles, and they have again voted a sum of £20 for prizes for Timber Exhibits. The Schedules have been revised and issued to all the Members. The Committee this year are—JOHN ANNAND, Overseer, Haystoun Estate, Woodbine Cottage, Peebles; CHARLES BUCHANAN, Overseer, Penicuik; ADAM SPIERS, Timber Merchant, Warriston Sawmills, Edinburgh; R. V. MATHER, Nurseryman, Kelso; J. W.

M'HATTIE, Superintendent of City Parks, Council Chambers, Edinburgh; JOHN LEISHMAN, Manager, Cavers Estate, Hawick; HENRY HENDERSON, Overseer, Dawyck Estate, Stobo, Peebles.

The General Meeting.

The General Meeting was held in the Showyard, Scotstoun, Glasgow, in the course of the Exhibition week, and was attended by a large number of Members. The printed Minutes contain a full Report of the Proceedings.

Excursion.

The Excursion last year was held in the west of Scotland, the places visited being the Society's Forestry Exhibition, the City Parks in Glasgow, Benmore in Argyllshire, Cessnock, Lanfine, Loudon, etc., in Ayrshire, and Erskine and Pollok in the neighbourhood of Glasgow. About seventy members attended. At the close of the Excursion it was found that there was a surplus in hand of about £16, and the Committee, with the approval of the Council, resolved to present to each member of the party who had paid his full share of the expenses, an enlarged photograph of the group taken at Benmore or Cessnock, and to present copies to the Proprietors and others who had received and entertained the party. Mr Richardson, the Society's photographer, has the photographs in hand, and reports that he hopes to have the whole of them issued to the members by the end of this week. A full Report of the Excursion will be found in the *Transactions*.

At the General Meeting the Council recommended that the Excursion next year should be made in the district round Newcastle. This was approved of, and the matter was remitted back to the Council, with powers. The programme sketched out by the Council is as follows:—Headquarters, Newcastle—two days to be devoted to Alnwick estates, one to Cragside, and one to Lambton Park and the Technical College, Newcastle. The various proprietors have been kind enough to grant the necessary permission, and the arrangements will be proceeded with in due course. The Duke of Northumberland has expressed a wish that the visit should be made as early as possible in August.

Last year an application was made by the Secretary to the various Scottish railway companies to have the Society placed upon the permanent list of Societies whose members are entitled to cheap fares from any part of the country to the head-quarters of the Society wherever they may be at the time of the Excursion. In reply to this application, the railway companies pointed out that as their arrangements last year for cheap fares

to Glasgow in connection with the Highland Society's show there would be available for members of this Society, the matter did not require to be dealt with then, but they promised that, if brought up again, it would be carefully considered. The Council accordingly propose to repeat the application this year.

The Council's Visit to Talla.

Through the courtesy of the Edinburgh and District Water Trust, the members of Council and officials of the Society visited the Talla Waterworks and catchment area on Saturday, 10th June last. They were met and shown over the works and area by Mr Wood, Convener of the Finance Committee of the Water Trust, Treasurer Anderson, and Mr Black, Superintendent. A memorandum, prepared by Mr Tait, the engineer, regarding the works and estate, had been handed to each member of the party. After the inspection, the party were entertained to tea by the Water Trust in the Victoria Lodge. Mr Wood welcomed the party, and said that the Trust were considering the advisability of planting some of the area. The President thanked the Water Trust for their kindness in permitting the Council to visit their estate, and for their generous hospitality, and expressed the hope that the bare hill-sides they had seen would soon be clad with trees. Treasurer Anderson returned thanks on behalf of the Trust, and said that they would be glad if the Society could visit the works on some other occasion. He mentioned that the Trust had an open mind as to planting, he thought they would do something, and he expressed his belief that planting there would be a paying concern. He was sure the Trust would give sympathetic attention to any further representations the Society might make on the subject. The visit, though short, proved a most interesting and instructive one.

In connection with this matter, the Council are gratified to be able to report that the Corporations of Liverpool and Leeds have already made some progress in the afforestation of catchment areas belonging to them, and they hope that the Edinburgh and District Water Trust may be in a position before long to carry out the President's suggestion.

Forestry Education.

Early last year the Council appointed a committee to obtain information from the Universities and Colleges in Scotland as to the various schemes in operation or in contemplation for providing Forestry Education. All the Universities and Colleges were communicated with, and replies have been received, but the Committee have thought it unnecessary to issue a formal

report at present. Meantime the Council have heard with much appreciation of the generous action of Mr John Mahler of Penissa Glyn, Bonygarth, Chirk, North Wales, in presenting to the Denbighshire County Council 50 acres of land for the purpose of an experimental station, by which the County Council is enabled to give effect to the recommendation of the recent Departmental Committee on Forestry, where it says, "that it is exceedingly desirable that College instruction in Forestry should be illustrated by means of example plots." These 50 acres will be the property of the County Council of Denbigh, but will be under the direction of the lecturer on Forestry in the University of North Wales, Bangor. The Council congratulated Mr Mahler on his public spirit, and thanked him for sending copies of his pamphlet on the subject.

Local Branches.

Mr CROZIER, forester, Durris, Drumoak, having represented to the Council that there was a desire amongst the members resident in Aberdeenshire that a local branch of the Society should be established there, the Council considered the matter, and while expressing their approval of the principle of local branches, they remitted to a Committee to go into the subject more fully and to report. The Committee's report has now been printed and approved by the Council, and will be submitted at a later stage of the proceedings.

Proposed Journal of Forestry.

At a recent meeting of the Council, Mr GILLANDERS, on behalf of the Royal English Arboricultural Society, mentioned that that Society had recently been considering the advisability of starting a Journal of Forestry, but that they thought it was very desirable that this Society should take a leading part in the venture, and suggested that a meeting of representatives of both Societies should be held at York to discuss the matter. The Council, however, thought it advisable in the first instance to appoint a Committee to consider the subject and report. The report has now been received, and the matter will be brought before the meeting at a later stage.

St Louis Exhibition.

Since last meeting a communication has been received from Colonel Watson, Secretary of the Royal Commission, sending a photographic reproduction of the reverse side of the Silver Medal awarded to the Society for the Photographs exhibited at St Louis, and an extract from a letter from the Secretary of Awards to the

effect that this reproduction may be used under certain conditions, and that the Diploma and the Medal in Bronze (according to the regulations of the Exhibition authorities) would be sent as soon as possible.

The Photographs which gained the medal were exhibited at the Royal Caledonian Horticultural Society's International Show in the Waverley Market in September last, and are now exhibited in the hall here for the inspection of the Members.

Sparks Bill.

Considerable disappointment was experienced when it was ascertained that this Bill had been so altered in Committee as to make the limit of compensation for damage to woodlands £100. It was considered that this practically rendered the Bill useless as regards woodlands, and the Council made a representation to that effect to the Board of Agriculture, which was duly acknowledged.

Library.

A list of additions to the Library since last meeting will be appended to this Report when it appears in the *Transactions*. (See Appendix E.)

American Forest Congress.

A Congress organised by the American Forestry Association was held in Washington in January 1905, and a copy of the *Proceedings* was purchased recently and added to the Society's library.

Canadian Forestry Convention.

A convention organised by the Canadian Forestry Association was held in Ottawa in the course of last month. It was attended by representatives from all the Canadian provinces, and was presided over by the Prime Minister, and the proceedings were opened by the Governor-General. If the *Proceedings* are published, the Council propose to purchase a copy for the Society's library.

Register of Foresters.

Situations for various estate men have been secured through the medium of the Register during the past year, but greater advantage ought to be taken of the Register by proprietors and others requiring estate men, and the Council again appeal to them to make use of it.

Laws.

The Committee have completed the work of revising the Laws, but the proposed revisions have still to be submitted and approved of by the Council before they can be submitted to the Society.

Annual Dinner.

Members are reminded of the Annual Dinner, which is to be held in the Royal British Hotel this evening at 6 o'clock, and is to be presided over by Mr Fothringham, the President.

The CHAIRMAN, in moving the adoption of the Report, said it was so full that it did not require many words from him. He had received a letter from the Honorary Secretary, Mr Munro Ferguson, M.P., the gist of which he might give them. Mr Ferguson said that, so far as promoting the objects of the Society were concerned—the good and intelligent afforestation of a great deal of this country—he did not look upon it as a means of employment for all the unemployed, because he thought if the present somewhat unthoughtout cry of spending a great deal of money upon forestry was taken up, it would probably lead to ill-considered expenditure, which would not produce good results, and would be discouraging to forestry generally in this country in the future. Mr Munro Ferguson was of opinion that it would be a good thing for the Society to send a strong representation, both to the Woods and Forests Department and to the Treasury, urging that some steps should be taken towards acquiring demonstration areas in this country as soon as possible. Proceeding, the Chairman said that the visit to the Talla had been a very interesting one. Those of the Council who were present formed the opinion that the area was well suited for forestry, and he hoped the Edinburgh and District Water Trust would use, at any rate, a part of the land for afforestation purposes. If that were done, it would make a good demonstration area within a comparatively easy distance of Edinburgh. The advantages of afforestation within catchment areas was one of the outstanding features of the United States Forest Congress Report, which he considered well worthy of the attention of the members of the Edinburgh and District Water Trust. Canada was following on the same lines. They might reasonably hope that their efforts were beginning to bear fruit when others besides themselves

were now seeing the necessity of improving forestry, not only in this country but all over the world, to keep up the supply of timber.

With regard to the *Transactions*, it was hoped in future to print notes of the observations of individual foresters which might be considered of sufficient merit by the Editing Committee. Many foresters, who did not feel equal to writing an ordinary paper, might send them short notes of their own observations, and he was certain such notes would add to the interest of the *Transactions*. That day it had also been decided to publish the *Transactions* once in six months instead of once a year as formerly. That decision had been partly brought about by a letter received from a member of the Royal English Arboricultural Society. He was not sure how far the letter emanated from the Society or from individuals, but it stated that the English Society contemplated starting a Journal of Forestry, and expressed the view that the Scottish Society should take a prominent part in the venture. The Council were not inclined to commit the Society to the publication of anything like a monthly or weekly journal; but they thought there should be more literature on the subject, and the outcome of their deliberations was to try publication of the *Transactions* twice a year, probably in January and July. That, at anyrate, would keep the Society more before the public, and he hoped they would approve of what had been done.

The Report was unanimously adopted.

Accounts.

Mr John Methven, Convener of the Finance Committee, submitted for approval the printed Abstract of Accounts for the year ending 31st December, which had been sent to the Members previous to the meeting. The Accounts showed that the Capital funds at the close of the year amounted to £1287, 15s. 8d., and that the balance of Revenue carried forward was £344, 4s. The Accounts were approved of. (The Abstract is printed as Appendix A.)

Dunn Memorial Fund.

Mr Methven also submitted the audited Accounts of the Dunn Memorial Fund for the past year, which showed a balance

of cash in hand of £10, 1s. 6d. The Statement was approved of. (See Appendix B.)

Excursion Fund Accounts.

Mr Charles Buchanan submitted an audited Statement of the Excursion Accounts, showing a balance at credit of £47, 19s. 3d., which, however, was subject to the cost of the Photographs, estimated at £16. This would leave a balance to be carried forward of about £31, 19s. 3d. The Statement was approved of. (See Appendix C.)

Office-Bearers.

On the motion of Mr Methven, seconded by Mr Scrimgeour, Mr Steuart Fothringham was re-elected President, and Mr John W. M'Hattie, Edinburgh, and Mr D. F. Mackenzie, F.S.I., Mortonhall, were added to the list of Vice-Presidents. In returning thanks for his re-election, the Chairman said he had been President for three years. While he was delighted to do anything he could for the Society, he thought that by changing their Presidents fairly often they spread interest in its affairs. It would be a good thing to look for a new President by next year, perhaps in some part of the country which had not been reached as yet. That, he thought, would be better than sticking to one man. At the same time, while he was President, he would do the best he could. He proposed the re-election of Mr Munro Ferguson, M.P., as Honorary Secretary, and of Mr Robert Galloway, S.S.C., as Secretary and Treasurer, both nominations being cordially agreed to. Councillors, in room of those retiring, were elected as follows:—Messrs John Boyd, Forester, Pollok Estate, Pollokshaws; A. T. Gillanders, F.E.S., Forester, Alnwick Castle; W. H. Massie, Nurseryman, Edinburgh; Charles Buchanan, Overseer, Penicuik; John D. Crozier, Forester, Durris Estate, Drumoak; W. A. Rae, Factor, Murthly; and James Whitton, Superintendent of City Parks, Glasgow. The Honorary Editor, the Assistant Editor, the Auditor, the Honorary Scientists, the Photographer, and the Local Secretaries were re-elected. Dr Borthwick was elected a member of the *Transactions* Committee and a Judge, in room of Mr Slater. The other members

were re-elected. (A detailed list of the Office-Bearers and others will be found in Appendix D.)

Proposed Journal of Forestry.

The Chairman said he had already explained the views of the Council on this matter. It had been put on the paper in case any of them might wish to make remarks upon it.

Sir Leonard Lyell, Bart., thought it would be a good thing, and would awaken interest in forestry, if they could arrange for a Journal of Forestry. There had recently been a very interesting conference in America, which it would have been useful to have had reported in this country. Dr Nisbet had also lately read a paper to the Society of Arts in London which many of them would have liked to be able to read and study. If they had a Journal of Forestry, these and other matters could have been readily brought before them, and they would be kept in touch with what was going on the world over. He did not see why their *Transactions* should not be published quarterly.

Mr Rutherfurd of Fairnington, Roxburgh, approved of the proposal to print notes from foresters embodying the results of their personal observations. Many men would supply short notes when they would not write papers.

Mr Cadell of Grange said that formerly the Royal Society of dinburgh only published once a year, but authors got tired of iting so long, and now they published papers in lots as they re read. It was a good idea to publish the *Transactions* four es a year if need be, instead of once, but the question of a gazine was rather a different one. The difficulty about a gazine was that they might not be able to keep up the erial and bring it out regularly at the appointed times.

ıe Chairman said that the bringing out of the *Transactions* a year instead of only once might prove but a preliminary If the change was successful, they might consider the on of publishing quarterly. But there were a good many to consider before they went that length, and the Council to proceed with caution. As to going in for a magazine nal published in alliance with the English Society, they d very much. It would mean the pledging of the credit ociety, and the information they got from the English was rather nebulous. The wish was simply expressed

that there should be a journal, and that they should take a prominent part in promoting it. They did not see their way to commit the Society at that stage. If anyone came forward with a feasible scheme, he had no doubt that they would be prepared to give it their best consideration, and place the matter before the General Meeting.

Forestry Exhibition at Peebles.

The Chairman stated that Schedules in connection with this year's Exhibition in the Highland Society's Show at Peebles had been sent out, and he hoped that Members would take the trouble to send in any interesting exhibits they could get hold of.

The Proposed Scottish National Exhibition.

Mr Galloway explained that when this Exhibition was first spoken about it was intended to hold it on a site in Murrayfield, Edinburgh, in 1907. It was found, however, that an Exhibition was also to be held in Dublin that year, and after conference on the subject it was decided to postpone the Scottish Exhibition till 1908. The site now proposed, if it could be obtained from the Corporation of Edinburgh, was part of the estate of Saughton, belonging to the town, and of which they were about to obtain possession. This site, it was believed, would be a very suitable one, and the promoters were hopeful that the town would make it available for this purpose.

Local Branches of the Society.

The Chairman moved—"That Local Branches of the Society be established in such centres as the Council shall approve of, for the purpose of promoting the objects of the Society, upon such conditions as to Membership and otherwise as the Council may from time to time determine." That matter, he said, had been brought forward from the Aberdeenshire district, and the Council, after consideration, had suggested that branches might be formed in Aberdeen, Inverness, Perth, and Glasgow. Mr Galloway was not quite clear that they were entitled under their rules to pass such a motion as he proposed at that

meeting, but if they were agreeable he would take the risk of the illegality of it.

Mr CROZIER, in seconding, said he thought Local Branches would be appreciated by those Members who could not attend meetings in Edinburgh.

In answer to Sir LEONARD LYELL, the Chairman said that the proposal to have their Annual Meeting at different parts of the country had been before the Society on former occasions, and it was always agreed to have the Annual Meeting in Edinburgh. The General Meeting had, in recent years, been held in the district where the Highland Society's Show or the Society's Excursion was held.

Mr GALLOWAY then read the Committee's Report, embodying the Regulations adopted by the Council regarding the formation of Local Branches, as follows:—

First. That Local Branches for Inverness, Aberdeen, Perth, and Glasgow would be useful auxiliaries in the work of the Society.

Second. These Branches could hold meetings for lectures and discussions; could arrange and carry out excursions; and conduct, encourage, or report on investigations and experiments; and they could contribute to the Society's *Transactions*. All the work of these Branches would be done by their own office-bearers, and a report of their proceedings would require to be submitted annually to the Council for presentation to the Society.

Third. A Local Branch could be formed upon the requisition of not less than 20 Members of the Society residing in the district. On receipt of such a requisition, the Council should instruct the Secretary to convene a meeting of the Requisitionists at the centre of the district, at which the requisition and these Regulations, as approved by the Society, should be read, and if the Regulations are adopted by the meeting, the Local Branch could there and then be formed.

Fourth. Members of the Branches should be Members of the Society, no others being admitted.

Fifth. The Society should make a grant of say £5 per annum towards the expenses of each Branch, but otherwise the Branches should be self-supporting.

Sixth. The Rules of each Branch would be made by its Committee, but would be subject to the approval of the Council of the Society; and after the Rules have been approved of by the Council, it should not be competent to the Branch to make any alterations on or additions to its Rules without the express approval of the Council.

Seventh. After the Branches are formed, it might be advisable that they should have direct representation on the Council of the Society. This could be kept in view in annually making recommendations to fill the vacancies on the Council.

The Motion and Regulations were unanimously passed by the Meeting.

Votes of Thanks.

Hearty votes of thanks were accorded to the retiring Office-Bearers for their services to the Society during their term of office, and to the President for presiding.

Lecture by Dr Borthwick.

At the close of the business meeting, Dr A. W. Borthwick, Hon. Consulting Cryptogamist to the Society, and Lecturer on Forestry to the Edinburgh and East of Scotland College of Agriculture, delivered a very interesting lecture, illustrated by lantern slides, on "The Possibilities of Artificial Manures in Forestry." A discussion followed, which was taken part in by Mr Cadell of Grange, Mr Gillanders, and others. A Report of the lecture and discussion will be found in the *Transactions*. On the motion of the Chairman, Dr Borthwick was cordially thanked for his lecture.

THE ANNUAL DINNER.

The Annual Dinner of the Society was held in the Royal British Hotel the same evening at 6 o'clock, the President in the Chair. The guests of the Society were Lord Ardwall; Treasurer Anderson, Edinburgh and District Water Trust; Dr Borthwick; Mr W. F. A. Hudson, Lecturer on Forestry to the West of Scotland Agricultural College; Mr R. B. Greig,

Fordyce Lecturer on Agriculture, Marischal College, Aberdeen; Mr W. Scott Stevenson, Secretary of the Edinburgh and East of Scotland College of Agriculture; Mr P. Murray Thomson, S.S.C., Secretary Royal Caledonian Horticultural Society; and Mr D. Young, *North British Agriculturist*. The usual loyal and patriotic toasts were duly honoured. Lord Ardwall proposed the toast of "The Royal Scottish Arboricultural Society" in a very interesting speech, and the President replied. Other toasts were "Educational Institutions," proposed by Professor Stewart MacDougall and replied to by Mr R. B. Greig; and "Our Guests," proposed by Mr James Johnstone and replied to by Treasurer Anderson. A cordial vote of thanks to the Chairman terminated the proceedings.

APPENDIX A.

ABSTRACT OF ACCOUNTS for Year ending 30th December 1905.

I.—CAPITAL.

CHARGE.

1. Funds at 31st December 1904,			£1284 10 5
£500 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 117¾,	£588 15 0		
£500 Caledonian Railway Company 4 per cent. Debenture Stock, at 124,	620 0 0		
Balance of Capital in Bank,	75 15 5		
2. Life Members' Subscriptions in 1905,		94 17 0	
New Members,	£78 15 0		
Ordinary Members by commutation,	16 2 0		
			£1379 7 5

DISCHARGE.

1. Proportion of Life Members' Subscriptions transferred to Revenue,			£84 1 9
Unexhausted: £639 14 11 / 77 9 5			
1/15 of Full Life Subscriptions,	£68 4 9		
1/10 of Commuted Subscriptions,	15 17 0		
2. Decrease in value of Railway Stocks at 30th December 1905,			7 10 0
3. Funds at 30th December 1905,			1287 15 8
£500 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 117½,	£587 10 0		
£500 Caledonian Railway Company 4 per cent. Debenture Stock, at 122¾,	613 15 0		
Balance of Capital, being sum in National Bank of Scotland, Limited,	86 10 8		
	£1287 15 8		
			£1379 7 5

II.—REVENUE.

CHARGE.

1. Balance in hand at 31st December 1904,			£304 4 2
2. Ordinary Members' Subscriptions,		297 5 0	
Arrears at 31st December 1904,	£33 7 0		
Subscriptions for 1905,	£326 10 0		
Less Received in 1904,	9 12 0		
	316 18 0		

DISCHARGE.

1. Printing, Stationery, etc.,			£197 11 9
Vol. XVIII. of *Transactions*,	£178 13 4		
And Authors' Reprints,	2 11 0		
	£181 4 4		
General Printing and Stationery,	33 15 3		
Forestry Periodicals, Binding, etc.,	7 7 11		

December 1905,	[illegible]		
Arrears at 30th December 1905,	41 15 0		
		58 7 0	
		£297 5 0	
3. Proportion of Life Members' Subscriptions transferred from Capital,			84 1 9
4. Dividends and Interest,			43 3 7
5. *Transactions*, etc., sold,			18 3 9
6. Income Tax Recovered,			1 18 8
			£748 16 11

Glasgow,		18 0 0	
			15 15 10
3. Forestry Exhibition at the Highland and Agricultural Society's Show at Glasgow—			
Printing,		£15 18 6	
Advertising,		1 0 0	
Other Outlays,		5 19 7	
			22 18 1
4. Donation to Edinburgh University Forestry Class to provide a Lantern,			10 0 0
5. Expenses of Management,			158 7 3
Rent,		£3 8 0	
Auditor,		3 3 0	
Reporter,		3 3 0	
Assistant Editor,		25 0 0	
Secretary and Treasurer,		65 0 0	
Advertising, Insurance, and Premium on Secretary's Bond of Caution,		4 2 5	
Outlays in connection with Annual Meeting and Dinner,		5 15 0	
Postages and Miscellaneous Outlays, viz.:			
Postages of 1904 *Transactions*,	£18 5 8		
General Postages, Commissions on Cheques, and Petty Outlays,	30 10 2		
		48 15 10	
		£158 7 3	
6. Balance of Revenue carried to next year (being sum in National Bank of Scotland, Limited), subject to payment of cost, etc., of 1905 *Transactions*,			344 4 0
			£748 16 11

EDINBURGH, *22nd January* 1906.—I hereby certify that I have examined the Accounts of the Treasurer for the year to 31st December 1905, of which the foregoing is an Abstract, and have found them correct. The Securities, representing the Society's Funds as above, have also been exhibited to me.

JOHN T. WATSON, *Auditor*.

APPENDIX B.

ABSTRACT OF ACCOUNTS

IN CONNECTION WITH

THE MALCOLM DUNN MEMORIAL FUND, 1905.

RECEIPTS.

Balance in Bank at close of last Account, . .	£7 4 6
Dividend on £100 3 per cent. Redeemable Stock of Edinburgh Corporation, payable at Whitsunday and Martinmas 1905, £3, *less* Tax 3s.,	2 17 0
	£10 1 6

PAYMENTS.

Nil.

Balance carried forward, being sum in National Bank of Scotland on Account Current, ...	£10 1 6

Note.—The Capital belonging to the Fund consists of £100 3 per cent. Redeemable Stock of Edinburgh Corporation.

EDINBURGH, 30*th January* 1906.—Examined and found correct. The Certificate by the Bank of above balance, and Edinburgh Corporation Stock Certificate, have been exhibited.

JOHN T. WATSON,
Auditor.

APPENDIX C.

Excursion Fund.

Abstract of Accounts for Year 1905.

Balance brought from last Account, . . .		£59 4 4
Additional Sums collected for Swedish Albums, .		4 4 0
		£63 8 4
Deduct—		
Auditor's Fee for 1904, . .	£2 2 0	
Payment to Mr Richardson for French Photographs, . .	23 15 0	
Printing Names on Photographs and Circular, ...	2 4 6	
Further Payment to Mr Richardson for Swedish Albums, being amount collected to date, .	4 4 0	
		32 5 6
		£31 2 10

Excursion to Glasgow, Argyll and Ayr shires.

RECEIPTS.

Contributions to Common Purse,	£129 16 9	
Less Repayments, ...	1 16 0	
	£128 0 9	
Sums received in advance for Photos,	0 8 0	
	£128 8 9	

PAYMENTS.

Hotels, ...	£65 7 9		
Railways, . . .	15 14 1		
Driving, . . .	22 15 0		
Printing Programmes, and Incidentals, . .	7 15 6		
		111 12 4	
			16 16 5
Balance carried forward to next year, being sum in National Bank of Scotland, Ltd., on Account Current, ...			£47 19 3

Note.—The above Balance is subject to payment of the price of Photographs taken at Benmore, etc., and the Auditor's Fee for 1905, estimated at £16.

Edinburgh, 30*th January* 1906.—Examined with Vouchers and Memorandum Book and found correct. Bank Certificate of above balance of £47, 19s. 3d. also exhibited.

John T. Watson,
Auditor.

APPENDIX D.

Office-Bearers for 1906:—

PRESIDENT.

W. STEUART FOTHRINGHAM of Murthly, Perthshire.

VICE-PRESIDENTS.

Sir KENNETH J. MACKENZIE, Bart. of Gairloch, 10 Moray Place, Edinburgh.
The Right Hon. the EARL OF MANSFIELD, Scone Palace, Perth.
Sir JOHN STIRLING MAXWELL, Bart. of Pollok, Pollokshaws.
JOHN W. M'HATTIE, Superintendent of City Parks, City Chambers, Edinburgh.
D. F. MACKENZIE, F.S.I., Estate Office, Mortonhall, Midlothian.

COUNCIL.

Sir THOMAS GIBSON CARMICHAEL, Bart. of Castle Craig, Malleny House, Balerno.
JAMES COOK, Land Steward, Arniston, Gorebridge.
GEORGE U. MACDONALD, Forester, Raith, Kirkcaldy.
WILLIAM MACKINNON, Nurseryman, 75 Shandwick Place, Edinburgh.
R. V. MATHER, Nurseryman, Kelso.
ADAM SPIERS, Timber Merchant, Warriston Saw-Mills, Edinburgh.
Colonel F. BAILEY, 7 Drummond Place, Edinburgh.
JOHN ANNAND, Overseer, Haystoun Estate, Woodbine Cottage, Peebles.
Dr A. W. BORTHWICK, Royal Botanic Garden, Edinburgh.
JAMES JOHNSTONE, F.S.I., Factor, Alloway Cottage, Ayr.
GEORGE LEVEN, Forester, Auchincruive, St Quivox, Ayr.
JOHN METHVEN, Nurseryman, 15 Princes Street, Edinburgh.
JOHN SCRIMGEOUR, Overseer, Doune Lodge, Doune.
DAVID W. THOMSON, Nurseryman, 113 George Street, Edinburgh.
JOHN BOYD, Forester, Pollok Estate, Pollokshaws, Glasgow.
A. T. GILLANDERS, F.E.S., Forester, Alnwick Castle, Northumberland.
W. H. MASSIE, Nurseryman, 1 Waterloo Place, Edinburgh.
CHARLES BUCHANAN, Overseer, Penicuik Estate, Penicuik.
JOHN D. CROZIER, Forester, Durris Estate, Drumoak, Aberdeenshire.
W. A. RAE, Factor, Murthly, Perthshire.
JAMES WHITTON, Superintendent of City Parks, City Chambers, Glasgow.

HON. SECRETARY.

R. C. MUNRO FERGUSON, M.P., of Raith and Novar, Raith House, Kirkcaldy.

SECRETARY AND TREASURER.

ROBERT GALLOWAY, S.S.C., 19 Castle Street, Edinburgh.

HON. EDITOR.

Colonel F. BAILEY, R.E., University Lecturer on Forestry, 7 Drummond Place, Edinburgh.

Note.—Dr NISBET was re-elected at the Meeting, but his resignation reached the Secretary the following day, and Colonel BAILEY was afterwards reappointed.

ASSISTANT EDITOR.

A. D. RICHARDSON, 1 West Brighton Crescent, Portobello.

AUDITOR.

JOHN T. WATSON, 16 St Andrew Square, Edinburgh.

TRUSTEES.

The EARL OF MANSFIELD, R. C. MUNRO FERGUSON, M.P., and W. STEUART FOTHRINGHAM of Murthly.

JUDGES AND TRANSACTIONS COMMITTEE.

Colonel F. BAILEY, Lecturer on Forestry, University of Edinburgh (*Convener*).
D. F. MACKENZIE, F.S.I., Estate Office, Mortonhall, Liberton.
JOHN ANNAND, Estate Overseer, Woodbine Cottage, Peebles.
A. T. GILLANDERS, F.E.S., Park Cottage, Alnwick, Northumberland.
Dr A. W. BORTHWICK, Royal Botanic Garden, Edinburgh; and
THE SECRETARY, *ex officio*.

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APPENDIX E.

Presentations to the Society's Library since the publication of last List in Volume XVIII.

Books.

1. *Forest Management:* 3rd Edition revised of vol. iii. of Dr Schlich's *Manual of Forestry.*
2. *Manual of the Trees of North America.* By Charles S. Sargent.
3. *The Country Gentlemen's Estate Book,* 1905.
4. *New Zealand Official Year-Book,* 1904.
5. *Practical Forestry.* 4th Edition. By A. D. Webster.
6. *Future Forest Trees.* By A. Harold Unwin, D.Œc.
7. *The Forester.* By Dr John Nisbet. 2 vols., 1905.
8. *Trees: A Handbook of Forest Botany for the Woodlands and the Laboratory.* Vols. ii. and iii. By H. Marshall Ward, Sc.D., F.R.S.
9. *The New Forestry.* 2nd Edition, 1903. By John Simpson.
10. *The Estate Nursery,* 1905. By John Simpson.
11. *Proceedings of the American Forest Congress,* 1905. (By purchase.)

Societies' Reports, Transactions, Etc.

12. *Annual Reports of the Smithsonian Institution,* 1903 and 1904.
13. *Transactions of the Highland and Agricultural Society,* 5th Series, vol. xvii., 1905.
14. *Transactions of the Natural History Society of Glasgow.* Vol. vi., part 3, 1901-02; and vol. vii., part 1, 1902-03.
15. *Transactions of the English Arboricultural Society,* vol. vi., part 1, 1904-05.
16. *Journal of the Royal Agricultural Society of England,* vol. lxv.
17. *Transactions of the Royal Dublin Society,* vol. viii., parts 6-16, and Index; and vol. ix., part 1.
18. *Proceedings of the Royal Dublin Society,* vol. x., parts 2 and 3; and vol. xi., parts 1-4.
19. *Economic Proceedings of the Royal Dublin Society,* vol. i., parts 5 and 6.
20. *Transactions of the Botanical Society of Edinburgh,* vol. xxii., part 4; and vol. xxiii., part 1.
21. *Report of the Department of Lands and Survey, New Zealand,* 1903-04.
22. *Report of the Bergens Museum, Norway,* 1902, 1903, and 1904 (in parts).
23. *Report of Madras Forest Department,* 1902-03.
24. *Memoirs of the Royal Caledonian Horticultural Society,* 1905.
25. *Calendar for* 1905-06—*Edinburgh and East of Scotland College of Agriculture.*
26. *The Estate Magazine,* 1905.

27. *Report of the Superintendent of Forestry, Canada*, 1904.
28. *Journal of the Royal Horticultural Society*, vol. xxix., part 4.
29. *Proceedings and Transactions of Nova Scotia Institute of Science*, vol. x., part 1, 1902-03.
30. United States Geological Survey Reports:—
    The Forests of Oregon.
    The Forests of Washington.
    Forest Conditions in the Cascade Range, Washington.
    ,, ,, ,, *Olympic Forest Reserve, Washington.*
    ,, ,, ,, *Northern Sierra Nevada, California.*
    ,, ,, ,, *Cascade Range Forest Reserve, Oregon.*
    ,, ,, ,, *San Francisco Mountains Forest Reserve, Arizona.*
    ,, ,, ,, *Black Mesa Forest Reserve, Arizona* (2 Copies).
    Teton and Yellowstone Park (Southern Part) Forest Reserves.
    The Priest River Forest Reserve.
    The Bighorn Forest Reserve.
    The San Jacinto, San Bernardino, and San Gabriel Forest Reserves. (Preliminary Report.)
    The San Jacinto, San Bernardino, and San Gabriel Forest Reserves.
    The White River Plateau and Battlement Mesa Forest Reserves. (2 Copies.)
    The Flathead Forest Reserve.
    The Bitterroot Forest Reserve.
    Summary of Forestry Work in 1899-1900.
31. *Report of Commissioners of Woods, Forests, and Land Revenues*, June 1905.
32. *Report of the Department of Forestry, Pennsylvania*, Years 1903-04.
33. *Transactions of the Massachusetts Horticultural Society*, 1904, parts 1 and 2.
34. *Canadian Forestry Association, 6th Annual Report*, 1905.

Reprints, Etc.

35. Bulletin No. 7. *Account of some of the Vegetable Productions of America.* Lloyd Library, Cincinnati.
36. Bulletin No. 8. *The Lycoperdaceæ of Australia, New Zealand, and Neighbouring Islands, with relative Plates.* Lloyd Library, Cincinnati.
37. Bulletins of Department of Agriculture, Victoria:—
    Emmer and Spelt.
    Alfalfa or Lucern.
    Trees and Shrubs tested in Manitoba and North-West Territories.
    Results of Trial Plots of Grain, etc.
    The Potato and its Culture.
    Milling and Chemical Value of the Grades of Wheat.
38. *Annual Report of Experimental Farms—Canada.*
39. *Records of the Australian Museum*, vol. x., No. 5.
40. *Windsor Park and Forest.* By William Menzies.

41. *On the Absorption of Electromagnetic Waves by Living Vegetable Organisms.* By George O. Squier, Ph.D.
42. *Working-Plan for the Alice Holt Forest.* By Dr Schlich and W. F. Perree.
43. *Crataegus in Eastern Pennsylvania.* By Charles S. Sargent.
44. *Recently recognised Species of Crataegus in Eastern Canada and New England.* By Charles S. Sargent.
45. *Reports on Afforestation of Washburn Valley Estate belonging to the City of Leeds in connection with their Waterworks.* September 1905.
46. *Reprints from Queensland Agricultural Journal, Forestry Section.* By Philip MacMahon.
47. Bulletins of Central Experimental Farm, Ottawa, Canada.
    Bacon Pigs in Canada. By J. H. Grisdale, Board of Agriculture.
    Insects Injurious to Grain and Fodder Crops, Root Crops, and Vegetables. By James Fletcher, LL.D., F.L.S., etc.
48. *Skogsvårdsföreningens Tidskrift:* Stockholm.
49. *Journal of the Board of Agriculture.*
50. *Forestry Quarterly.* New York.
51. *Journal of Agriculture of Victoria.*
52. *Forestry and Irrigation.* Washington.
53. *Timber Trades Journal.* London.
54. *Journal da Commerce des Bois.* Paris.
55. *Timber News.* London.
56. *Agricultural Economist.* London.
57. *The Indian Forester.* Allahabad. (By purchase.)
58. *Revue des Eaux et Forêts.* Paris. (,,)
59. *Allgemeine Forst- und Jagd-Zeitung.* (,,)
60. *Zeitschrift für Forst- und Jagdwesen.* (,,)

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OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

LIEUT.-COLONEL F. BAILEY, F.R.S.E.,
HONORARY EDITOR.

A. D. RICHARDSON,
ASSISTANT EDITOR.

ROBERT GALLOWAY, S.S.C.,
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Photo. ROYAL SCOTTISH ARBORICULTURAL SOCIETY AT LAMBTON PARK, 1ST AUGUST 1908 *A.D.R.*

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

I. The Planting of High Moorlands.[1]

By Sir JOHN STIRLING-MAXWELL, Bart. of Pollok.

Two conditions appear essential to the creation of new forests in the Highlands, one a rise in the price of timber, and the other some measure of assistance from the State, certainly in the way of instruction and experiment, and possibly also in the way of loans. Since there are at last signs of both these conditions being fulfilled, and since, moreover, the fall in the value of sheep farms and irregular demands for deer forests afford a new opportunity, the subject of hill-planting certainly deserves all, and more than all, the consideration it is receiving.

It is admitted by everyone that plantations will not pay unless they are made on a considerable scale, and managed in the most economical and scientific manner. The object of this paper is to illustrate how much remains to be learnt in one important branch of forestry, namely, the planting of high moorlands. In such situations the fact that the land is at present almost valueless will compensate for some increase in the cost of planting and the slow growth of the first crop. In sheep farms and deer forests, for example, it would be fatal to both farming and sport to plant the best grazing ground, but there are usually in such farms and forests extensive tracts which have little value for sheep, deer or grouse, where the shelter of large plantations would more than compensate for any loss of grazing.

My experiments in this line (if I may dignify them by this name) have been carried on since 1892 on moorlands in the upper basin of the river Spean, varying in altitude from 1250 to 1500 feet. The tract of which they form part is used as a deer

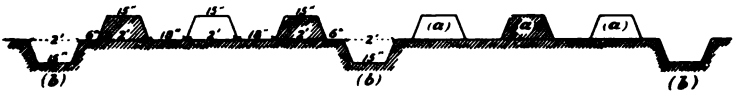
[1] Paper read at Society's Forestry Exhibition in connection with Highland and Agricultural Society's Show at Peebles, 19th July 1906.

forest, being fit for nothing else. Between 500 and 600 acres have been enclosed for planting without in any way diminishing the value of the deer forest, as none of the good grazing ground has been included. The plan adopted was to plant first all the ground that could be planted as it stood, and afterwards gradually to drain and plant the remainder, if the success of the first experiment justified the expense.

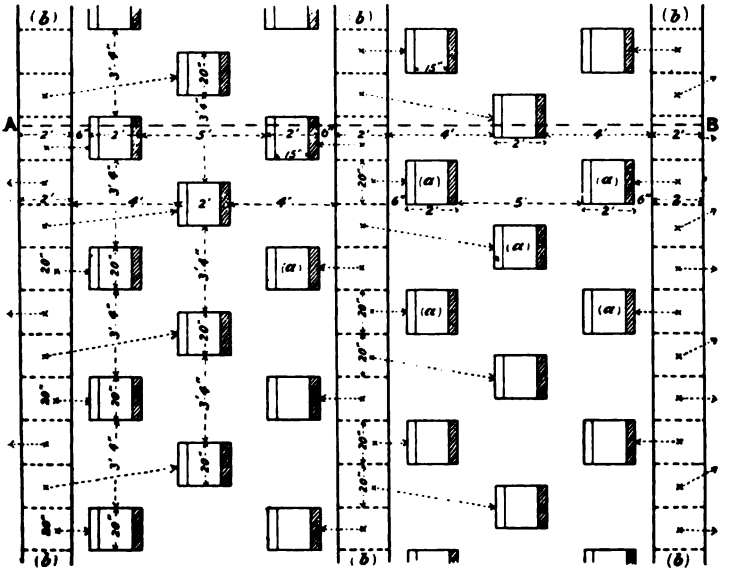
The results of draining and planting in the ordinary Scotch fashion have been disappointing. The heavy rainfall, and the retentive character of the peat render draining useless unless the drains are very close together. The matted texture of living peat, which the roots of young plants are very slow to pierce, seems also to exaggerate the inherent evils of notching. The roots tend to develop in the plane on the notch, and if they have been twisted in planting, the root-system has no chance of righting itself, and becomes hopelessly deformed.

A trial is now being made of the system recently perfected in Belgium to meet the same difficulties. This system was briefly described in the reports of the recent visit of the English Arboricultural Society to Belgium. I only wish we had heard of it sooner. The moors on the frontier of Belgium and Germany very closely resemble ours in soil and climate, and in the plants which cover them. A proof that the resemblance is not superficial is found in the success with which Scots grouse have been naturalised there, an experiment which, as far as I know, has succeeded nowhere else. The Belgian Government is now planting so much of these moors as is public property up to a level of about 2000 feet, and private owners are beginning to follow its example. It was found that plants notched into peat at this altitude made no progress at all for five or six years. That delay is now avoided by setting every plant in the centre of a large turf turned upside down. This proceeding is not nearly so expensive as it sounds. The ground has to be drained in any case, and numerous shallow drains are found to succeed best. These are carefully calculated to supply the number of turfs required. The Belgian Government plants very wide, usually at 6 feet both ways,—its object being to convert a vast extent of moorland into forest as soon as possible. The Government foresters themselves consider this distance too wide, and I observed that the plantations on an adjoining property were being made at about 4 feet. Let us

take this example as better suited to Scotland. To plant at about 4 feet, drains will be required every 12 feet, with three rows of plants between. If they are made 2 feet wide at the top, tapering to 15 inches at the bottom, and 10 inches deep, and the turfs are cut every 20 inches, the drain will yield exactly the



SECTIONAL ELEVATION ON A. B.



PLAN

REFERENCES

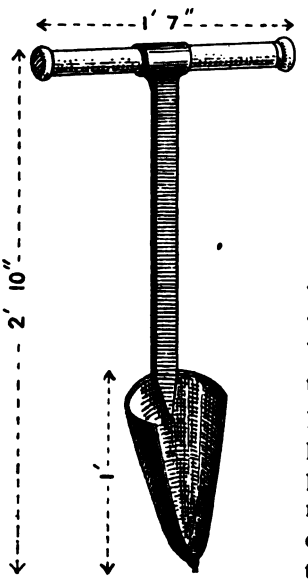
(a). Inverted Turfs
(b). Drains from which the Turfs have been dug.
Note:—The Arrows indicate the manner of distribution of the Turfs.

WET MOORLAND PREPARED FOR PLANTING ON THE BELGIAN SYSTEM.

number and size of turfs required. As the drain is formed, the first, second, and third turfs are thrown alternately to left and right, always face downwards. The only extra labour consists in moving the third turf to its place in the middle row, a distance of 6 feet (see Plan); and this is repeated throughout the whole

length of the drain. Larger ditches which may be required to carry off the water are, of course, not included in this calculation.

Now as to planting. The turfs are left for a year. By that time the ground has begun to dry, the turfs have sunk considerably, and the herbage below them has begun to decay. They are not good subjects for notching, as the notches would be apt to gape in dry weather. But they are very good subjects for what may be called miniature pit-planting. A heap is made of the best soil or gravel available near the spot, and this, if pure, is mixed with basic slag, about half an ounce of slag to the cubic foot of soil. The planter cuts a circular plug from the centre of each turf with a long-handled planting trowel (see Illustration), leaving a hole deep enough to allow the roots of the young plant to be spread out to their full depth. In this hole the tree is planted with two small handfuls of the prepared soil, while the plug is broken up to fill in the top.



The cross handle is of wood—the rest of iron.

PLANTING TOOL USED IN BELGIUM.

Trees planted in this fashion seem to suffer little more interruption in their growth than would be occasioned by a move from one part of the nursery to another. The extra expense is partly made up by the use of smaller plants, which soon outgrow larger plants which have been notched into natural surfaces five or six years earlier. On the Belgian moors, where they plant little except spruce, these are usually four years old (two years in the seed-bed, and two years transplanted). But Scots pine, two years old, would be quite suitable for the purpose, and could be taken straight from the nursery if they had not been sown too thick.

There is nothing startlingly new about the system. Its merit lies in its nicely calculated adjustment of methods already well known. The extra cost of making the ground ready for planting is not great. Indeed, where close draining is necessary, there is no extra expense, the only difference being that the output

from the drains is utilised in place of being an encumbrance. There must be added the cost of preparing the soil used in planting, and a boy to carry it in baskets to the planters. The actual work of planting proceeds in Belgium as quickly as notching.

I should be reluctant, without further trial, to advocate the system for whole plantations, though it is so used in Belgium, but I feel no doubt whatever that it will be of value in Scotland in making moorland plantations solid. It seems especially applicable to those spongy hollows which are found on most moors, and too often form gaps in plantations. Such hollows and flats, where the peat, permeated by burns and springs, contains layers of sand and grit, are very hopeful subjects for planting when drained, but are commonly covered with a close, matted herbage, in which notched plants rarely make satisfactory progress. To test the value of the part the prepared soil plays in the system, experiments have been made in Belgium of planting with slag alone and with soil alone, as well as with the mixture of both. The slag alone gives very poor results. The soil without slag has succeeded better, but the best results have followed the mixture of the two. This agrees with my own experience. Plants notched into peat with slag six years ago have done no better than those which were given none. But where the ground has been trenched, the addition of slag has always made a conspicuous difference.[1]

There is probably as much still to be learnt about the kind of trees to plant on high ground as about the method of planting. The roots embedded in our high moorlands belong for the most part to vanished forests of Scots pine. Everyone has mused on the mysterious disappearance of these forests. Were they the victims of some great epidemic? The formation of peat is frequently attributed to their decay, but this theory does not tally with the fact that the largest roots are often found growing on deep beds of peat. It seems reasonable to suppose that Scots pine will grow again where it grew before. But it by no

[1] The method of planting described by the author has the further advantage of securing regularity of distribution, the lines of plants and the drains at the same time facilitating systematic inspection, "beating up," and other operations, many of which are difficult, or even impossible, to carry out effectually without some such guides through the dense crop, especially during the period which must elapse before the lower branches die and fall.—HON. ED.

means follows that other trees will not grow better. Considering how long exotic conifers have been discussed and planted in this country, it is maddening to reflect how little is known of their value as timber and fitness for various situations. We know what they will do on a British lawn; we want to know what they will do in a British wood. In Belgium the Weymouth pine and common spruce are both found to be more hardy than the Scots pine, which now does not figure at all in the highest plantations. In Scotland the Sitka spruce (*Picea Menziesii*) and Oriental spruce, as well as *Tsuga Albertiana*, seem less checked in growth at high elevations than the Scots pine. *Pinus Cembra*, always a rather slow grower, grows as fast in a poor gravel at 1400 feet as it does in a lowland garden. Its strong root-system, long life, and indifference to wind, seem to point to it as a valuable windbreak on exposed ridges. Its timber is not despised in Switzerland. Dr Augustine Henry (from whom more can be learnt in a few hours than from a hundred books) called my attention to another tree which deserves a trial. This is a variety of *Pinus montana*, an erect-growing tree with a stem of 60 feet, which forms immense forests in the Pyrenees at elevations where the Scots pine ceases to thrive. By some odd chance this tree has escaped notice in Britain, and it is hard to find even a specimen of it in our gardens. The only specimen I can be sure of is in the Botanic Garden at Dublin, where it grows as straight as a mast, and measures now about 30 feet. But the value of this tree is appreciated by the French Government, which has built an establishment at Mont Louis for drying the seed, and employs it under the name of *Pin à Crochets* wherever high and poor ground has to be brought under forest. It is usually mistaken by travellers for Scots pine or Austrian pine, in spite of its grey bark, short, dark leaves, and distinct habit. No account of this tree will be found in English books on forestry, but it is well described in Captain S. E. Cook's *Sketches in Spain* (1834), and some of the same author's notes are quoted in Loudon's *Arboretum*, 1838.[1]

In the Pyrenees the timber is considered better than Scots pine, being somewhat slower in growth, more resinous, and more durable. The seventeenth-century barracks at Mont Louis

[1] The tree is described in Boppe's *Traité de Sylviculture* and other French works on forestry.—HON. ED.

are roofed with it, and the timbers are still quite sound in that trying climate. The Pyrenean foresters told me that they found the tree particularly valuable for windy plateaux. It is less exacting than Scots pine as regards drainage, and it will probably succeed well in peat. The dwarf variety certainly thrives in Scotland on beds of peat where Scots pine fails.

The same or a similar variety of *Pinus montana* appears to be found in the French Alps. It is known as *Pin de Briançonnais*, and has been planted in the Danish forests since 1886. I have not seen this tree either in the Alps or in Denmark, but Mr Rafn of Copenhagen, who can supply seed gathered in Denmark, writes that the tree is maintaining its erect habit well, though it is too early to be sure of its value as a timber-tree. The seed of the Pyrenean variety can be obtained from Mont Louis through the British embassy at Paris. It has been regularly supplied for the last three years to the Norwegian Government. The seed has been distributed among the various tree-growing establishments in Norway, and it is anticipated (says H.M. Chargé d'Affaires at Christiania) that the tree will prove of value, though it is too early to form any definite opinion as to whether it will suit the country or not.

It is now time to conclude this paper, or I might remind you that other promising forest trees, such as the Omorika spruce, the giant *Thuya*, and the Nootka cypress, still wait their trial at high elevations in Scotland, while the seed of the Occidental larch, which is perhaps the most promising of all, has only yet reached this country in ridiculously small quantities, and is not even to be found in all our botanical gardens.

I trust that in these observations I have not seemed to speak dogmatically. No one has less right to do so. My object has been to show how much remains to be learnt about the planting of high ground in Scotland, and to commend this fascinating subject of study to all those who desire to see our bare glens repeopled with trees and busy with the healthiest of industries.

2. Development of a Larch Crop.

(With Plate.)

By A. MURRAY, Forester, Murthly, Perthshire.

A great deal has been written about the formation and rearing of plantations, but it is only occasionally that one learns anything about the value of, or the income derived from, middle-aged and mature woods.

To state in detail how woods should be managed so as to become a source of profit to their owners is not the object of this paper; but I feel confident that land under properly managed woods will yield a higher return per acre than it will under grazing, or even in many cases under agricultural crops, involving, as they do, the upkeep of expensive buildings, fences, drains and other contingencies.

The following measurements of six larch trees growing in a plantation on the Murthly estate show the annual increment of wood produced by them during the last fourteen years, and they furnish an illustration of the profit which may be expected from a middle-aged wood of this sort. The crop is of pure larch, about forty-two years of age, and the trees stand about 11 feet apart on the average. The plantation was first thinned, at the age of 27 years, during the spring of 1891, at which time I marked and carefully measured these six trees. At that time I formed the opinion that the first thinning (for a crop of larch) had been too long delayed, as the trees seemed to be too tall and slender for the position they occupied, while the amount of living foliage was also too small for a light-demanding tree of this sort. The soil is thin and gravelly, and rests on slate-rock, at an elevation of from 600 to 900 feet above sea-level. The exposure is south-easterly, and the plantation is somewhat sheltered from the north-east. The prevailing winds are from the north and west. The adjoining land is let for hill-grazing, at a rent of about one shilling per acre.

The measurements and increments of the trees referred to were as follows:—

[*A. W. Brown.*

LARCH PLANTATION AT MURTHLY.

Note.—The tree with the white band near the centre of the photograph is No. 4 of the List.

[*To face page 8.*

Year.	Girth in Inches at 5 Feet above Ground.					
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
1891, . . .	25	20½	24½	30½	25	21½
1892, . . .	...	21½	26	31	26	22
1893, . . .	...	...	26⅜	31½	27¼	...
1894, . . .	...	22⅜	27¼	32	28	23
1896, . . .	28	24	28½	33	29⅜	24½
1899, . . .	29½	25⅜	30¼	34¼	32⅛	26
1900, . . .	...	26⅜	...	...	...	...
1901, . . .	...	...	...	35½	33¼	...
1902, . . .	31⅝	27⅛	31½	36	33⅛	28½
1905, . . .	35	28½	33½	37½	36	30⅞

The girth, height, and volume in 1891 and in 1905, with increase due to growth during the interval of fourteen years, are given below. The girths were measured at 5 feet from the ground and the heights to the topmost twig.

Nos.	1891.			1905.			Increase during the intervening 14 Years.		
	Girth.	Height.	Volume.	Girth.	Height.	Volume.	In Girth.	In Height.	In Volume.
	Inches.	Feet.	Standard Cub. Feet.	Inches.	Feet.	Standard Cub. Feet.	Inches.	Feet.	Standard Cub. Feet.
1	25	42	7·292	35	58	19·736	10	16	12·444
2	20½	40	4·669	28½	57	12·860	8	17	8·191
3	24½	45	7·503	33½	51	15·898	9	16	8·395
4	30½	44	11·369	37½	62	24·212	7	18	12·843
5	25	42	7·292	36	60	21·600	11	18	14·308
6	21½	34	4·365	30¼	52	13·769	9⅜	18	9·404
	Average volume per tree,		7·081	Average volume per tree,		18·012	Average volume per tree,		10·931
	Representing, by Quarter-girth Measurement, c. ft. 5·311			Representing, by Quarter-girth Measurement, c. ft. 13·509			Representing, by Quarter-girth Measurement, c. ft. 8·198		

These six trees were selected as it seemed unlikely that they would be removed in future thinnings; but owing to their being more isolated than most of the others, they are above the average size of the trees forming the crop. From careful measurements, however, I found that the average volume per tree, taken over the whole area, was fully 8½ cubic feet (quarter-girth measurement). Two acres (each in a different part

of the plantation) were carefully measured, and the trees, exclusive of a number of smaller sized and suppressed trees, were counted; they were found to contain 365 and 380 trees respectively, thus giving an average of 372 trees per acre. At $8\frac{1}{2}$ cubic feet per tree, this gives 3162 cubic feet per acre; and taking this quantity at the very moderate estimate of 6d. per cubic foot, the present value would be £79 per acre, giving a gross return of £1, 17s. 10d. per acre per annum for the forty-two years. The price of the thinnings in 1891, together with many more which have been taken out since then for estate purposes, would much more than cover the expense of planting and tending to this date. In order to test the accuracy of my valuation, I got one of the leading timber merchants in the locality to make a careful examination of the wood (with which he expressed himself as well pleased), and on comparing his valuation (which he stated he would willingly pay should the crop be put on the market) with my own, his was found to be slightly higher. This is by no means the proper time, however, to value a young thriving plantation such as this is, and the figures are given here merely in order to show what the possibilities of a larch plantation grown on very poor heath mountain-land are. Until a few years ago, growth in height had been stimulated at the expense of growth in girth; but now that the trees have got more growing-space, growth in girth will be more rapid, and as they increase in size an annual ring of normal width will add considerably more to the cubic contents than formerly.

To point out that the cultivation of woods, even though only of pit-wood size, can be made a means of augmenting the income derivable from semi-waste land has been my endeavour here. I trust that the foregoing data will sufficiently demonstrate that this can be done, and that all those interested in the matter may give the formation and management of such plantations an impartial trial. For pit-wood alone, the supply of which is mostly got from abroad, there is an ever-increasing and steady market, amounting at present to something like £6,000,000 per annum. With close planting of suitable species, the after-management of the crop being conducted with a view to early realisation, a great deal of this sum could be kept at home. In the management of plantations, however, the aim should be to produce timber which will best suit the requirements of the local markets, and the system should

be adapted to the situation in which the trees grow. Thus, in mining districts, and on many soils and situations which, although suited to its growth, are not at present sufficiently accessible for the removal of heavy timber, the crop should be reaped when of a size at which it would be saleable for pit-wood, and it should be reared with this end in view. Under this system two crops could be grown in the time it would take to grow one of heavy timber.

It is obvious that the planting of many of our hill-sides with suitable trees would add to the commercial value of any property, and to the pecuniary interests of the inhabitants, by giving employment to many who, for lack of it, are leaving the country. In addition to this, other and very important advantages, such as shelter to the surrounding arable and pasture land, would be likely to arise from extensive planting; while landowners would ultimately reap immense profits as compared with their income from the same land at present. The products of the forest are to us positive necessities; yet, although we have so much available land suitable for the growth of first-class timber, we are mainly indebted to the foreigner for our supplies. For these large tracts of land, for which there is at present little or no use, there could not be a better investment than their conversion into forests, which, if not always remunerative to the actual planter, would certainly be so to his successors. I have never yet met with an instance in which the produce of a forest could not be profitably disposed of; and the more timber there is grown, the more will be sold; while with improved methods of management, combined with the rearing of species producing first-class timber, the uses of home-grown timber will be wider, and an increase in its price certain.

3. Forest Policy in the British Empire.[1]

By J. S. G.

The popularity of Dr Schlich's important text-book is well attested by the need for a third edition of the first volume in so short a period as seventeen years. The first edition, published in 1889, and entitled *Utility of Forests and Fundamental Principles of Sylviculture*, was followed in 1896 by a second edition, when the title was altered to *Introduction to Forestry*, and enlarged by the addition of chapters on "The State in Relation to Forestry," and "The Timber Requirements of the British Empire." The third edition, now before us, shows a further change; for the second half, on the "Principles of Sylviculture," has been transferred to Vol. II., and the name has again been changed to *Forest Policy in the British Empire.*

As before, the book is divided into three parts—

Part I. The Utility of Forests.
Part II. The State in Relation to Forestry.
Part III. Forestry in the British Empire.

An Appendix to Part III. treats of "Forestry in the United States of America," and it seems a pity that a Part IV. could not have been added, giving a brief account of forestry in other foreign countries.

A special feature of the new edition of Vol. I. is the addition of a number of excellent photographs, illustrating the trees and forest work of the chief forest regions of the empire, and especially those of India and British North America.

The Introduction to the volume is an important and interesting piece of work. Dr Schlich begins by showing how forest once covered the greater part of the dry land of the earth; how the interference of man, requiring wood for his use, or the absence of wood for the cultivation of food products, introduced the first branch of forestry, *Forest Utilisation;* how a step in advance was made when man required the possession of portions of forest which he could work for his own advantage, and so a second branch was brought in, *Forest Protection;* how, again, it was found that mere protection was not enough, but regularity of yield was required, and so a third branch was formed, the

[1] *A Manual of Forestry*, by Dr W. Schlich, C.I.E., F.R.S., Etc. Vol. I., 3rd edition, 1906 (Bradbury, Agnew & Co.).

Preparation of Forest Working-Plans; how, further, the requirements of reproduction, and the study of the characteristics of woods and the trees that composed them, led to a fourth branch, *Sylviculture;* how this had to be supplemented by means of valuation, requiring a fifth branch of *Forest Valuation* or *Forest Finance;* how the need of legal means of securing rights in forest property formed the sixth branch, *Forest Laws and Forest Regulations;* and how, finally, it became necessary for States to determine how far forests were wanted and should be maintained, and a seventh branch, *Forest Policy*, was made.

Dr Schlich's definition of a "forest" is "an area which, for the "most part, is set aside for the production of timber and other "forest produce, or which is expected to exercise certain climatic "effects, or to protect the locality against injurious influences," and he contrasts this with a "wood," which is "an area stocked "with trees or shrubs, or both, and managed for the production "of timber, firewood, and such other produce as ordinarily "accompanies the rearing of trees," so that every wood is a forest, but every forest is not necessarily a wood.

Chapter I., on the "Direct Utility of Forests," explains that the direct effects of forests are due to the produce which they yield, the capital which they represent and the work which they provide. The produce is either "principal," that is, timber and fuel, or "minor," represented by a great number of products—leaves, flowers, bark, extracts, fibres, etc. The capital of forestry consists chiefly of the soil and the growing stock of wood. The work provided by forests consists in the labour required for administration, formation, harvesting, etc.; in that necessary for the transport of produce; and in that required for industries which are dependent on forests for their prime material. Dr Schlich states that in Germany about eight million pounds are paid annually for administration, etc., maintaining about one million of people; that about four million pounds are paid annually for transport; and about thirty million pounds, maintaining three million people, are spent in forest industries. These statistics are important, and show the value of forests in giving employment to the population.

Chapter II., on the "Indirect Utility of Forests," describes the effect of forests—(1) on the temperature of the air and soil; (2) on the moisture of the air and the movement of water in nature; (3) mechanically; (4) hygienically; and (5) æsthetically.

Dr Schlich summarises the effects on temperature as justifying the following conclusions :—

"(1) The climate of forest countries is more equable than that of open countries.

"(2) The mean temperature of soil and air in forest countries is somewhat lower than that of soil and air in open countries.

"(3) The reduction of the temperature may act beneficially in hot countries, but it may be injurious in countries removed from the equator, where the temperature is already lower than is good for the ripening of field crops.

"(4) Vegetation awakens later in spring in well-stocked forests than in open ground.

"(5) As forests moderate the extremes of temperature, plants growing under the shelter of a forest crop are less liable to suffer from late and early frosts, or from drought, than plants growing in the open."

On the important question of the effect of forests on the moisture of the air, Dr Schlich summarises the data, chiefly German, which he discusses, by saying that "the mean annual excess in "forests ranges from 3 to 10 per cent., which explains why dry "currents striking through forests may become, in a short time, "relatively moist, so that precipitation may be caused. At any "rate, there can be no doubt that the formation of dew is much "greater in the vicinity of forests than on open ground away from "woodlands." He shows that, although some 23 per cent. of the rainfall is intercepted by the crowns of trees in a forest, more of it actually penetrates the soil than does so in the open.

Mechanically, it can be shown that of the rain falling on a forest, close on one-fourth is intercepted by the crowns of the trees, the other three-fourths falling on and being absorbed by the humus instead of running off in surface streams. Hygienically, forests, Dr Schlich points out, assist in the production of oxygen and ozone, and usually improve the healthiness of a country. Æsthetically, they may exercise a beneficial influence on man.

Part II. discusses the "State in Relation to Forestry," maintaining that it is for the State to guard the interests of the

community where necessary, for the State alone can give sufficient guarantee for continuity of action. He shows that forests of "Protection" are sometimes required for the preservation of the soil or of the water-supply; for protection against winds; for the benefit of public health, or for the defence of the country, etc.; that "State" forests are often very desirable to safeguard supply; that the forests of communes, corporations, etc., are often best managed by State agency; and that State supervision is often very necessary even in the case of private forests.

Part III., "Forestry in the British Empire," is probably the most generally interesting part of, as it certainly occupies the largest space in, Dr Schlich's new volume. The area of the empire is given approximately as 12 million square miles, and the population at 400 millions. Of this population, of course the largest share is set down to India, which has over 294 millions, but the chief areas are in Canada and Australia.

India is the first country dealt with, and here Dr Schlich is clearly at home in his knowledge of the country and of what has been done in the matter of forest-conservancy. The subject has often been discussed and written about, so that it is unnecessary to describe in detail the account given by Dr Schlich of the establishment of the Forest Department and the work it has done. The pictures are a great help to those who have not been in India, in assisting them to realise what the forests in India and the chief trees are like. Mr Jackson's pictures of the teak plantations in Malabar give a clear idea of the appearance of teak when young or old; Mr Milward's sál photographs are equally instructive, and the Himalayan views taken by the same officer give a good idea of the appearance of the forests of deodar, pine and spruce. The total area of Government Forest in India is given at 232,701 square miles, being 24 per cent. of the area of the British districts of the country. This area is managed by a staff of 200 Imperial service officers, 112 Provincial service, 437 Executive, and 9759 Protective service. The annual net revenue amounts to about £670,000, to which may be added £205,000, the value of produce given away free —total, £875,000. The only tree giving an export wood of any importance is the teak (*Tectona grandis*).

In Ceylon there is a small department managing 10,567 square miles of forest, being 42 per cent. of the area of the island, but

in much of this the protection is as yet not very much advanced; and to account for this Dr Schlich says: "The fact seems to be "that the Ceylon Government has, in reality, never been quite in "earnest to carry out an efficient scheme of forest conservancy." The net revenue is about £5600, and there is a conservator with eight assistants. The chief trees yielding export woods are the ebony (*Diospyros Ebenum*), the satinwood (*Chloroxylon Swietenia*), halmilla (*Berrya Ammonilla*), ironwood (*Mimusops indica*), and the Palmyra palm (*Borassus flabelliformis*).

In the Straits Settlements, and in the Federated Malay States, forest work has begun in real earnest on a definite basis, and especial attention is to be paid to the gutta-percha tree (*Palaquium Gutta*).

The forests of Australasia and their timber resources are very fully dealt with. The area includes the Australian Commonwealth and New Zealand, the former of which has 166,000 square miles and the latter 32,000 square miles of forest, being 6.4 per cent. of the total area. Everywhere there are the remains of immense forests of valuable timber-trees, but nothing of any consequence seems to be done to arrest the gradual clearing of all these forests, or even to secure to the Government a reasonable proportion of the value of the trees removed. It may be hoped that copies of Dr Schlich's book will find their way to Australia and New Zealand, and that some of the ardent politicians in those countries will take the matter up and endeavour to get it made a national question, apart from local party politics, so that the terrible consequences which may be expected from gradual complete denudation may be avoided in time.

"Of all the colonies, the Cape has most successfully grappled with the forest question." These are the opening words of Chapter III., and Dr Schlich's detailed account explains what has been done in each of the Cape colonies. Nearly everywhere, partly because the indigenous trees are of little value and of slow growth, plantations have had to be made, and in Cape Colony the chief tree planted is the cluster pine (*Pinus Pinaster*). A small but efficient staff has been organised in each colony, and good work is being done in all. Small beginnings have also been made in other African colonies, as in Nigeria, the East African Protectorate, and, chief of all, the Soudan. In the latter the chief demand is for fuel for the railways and the Nile

steamers, and the most valuable trade is that in gum-arabic, the produce of several species of *Acacia*, and especially of *A. Verek*, the "hashab" tree.

Of all parts of the empire, however, the most important, in a forest sense, is the Dominion of Canada, and, according to Dr Schlich, there seems some small chance of the urgent question of safeguarding the timber resources being taken up seriously. He gives the area of woodland as 1,249,000 square miles, or 38 per cent. of the total area of the Dominion. The importance of the timber-trade is gauged by the following statistics:—

Removals of timber in one year,	503,527,545 cubic feet	=	10,070,551 tons.
,, firewood ,,	707,682,080 ,,	=	14,153,641 ,,
	Total,		24,224,192 tons.

The value of the material removed is estimated at £10,216,539. Dr Schlich says: "It is of the utmost importance, not only for "Canada, but for the empire generally, that the Canadian forests "should, at an early date, be taken under systematic manage- "ment. The Governments of the several provinces should make "up their minds to select and demarcate a sufficient proportion "of the area as permanent State forests, and bring them under "complete control and systematic management. There are large "areas to choose from, so that no difficulties are likely to present "themselves in selecting out of the one and a quarter million "square miles, say, 150,000 square miles to be reserved, leaving "more than one million square miles for unrestricted lumbering "and extension of cultivation." In the early part of this year (1906) a Forest Convention met, under the presidency of the Governor-General and with the support of Sir Wilfred Laurier the Premier, and resolutions were passed indicating the chief points to be attended to. It may be hoped that from this beginning will start a real endeavour to preserve the Canadian forests and regulate their exploitation.

In other American colonies much has already been done, and most especially in Trinidad.

Interesting as is Dr Schlich's account of the work done for forestry in the various outlying parts of the empire, members of the Royal Scottish Arboricultural Society will turn with even greater interest to Chapter V., on "Forestry in the United Kingdom," especially as Dr Schlich is so well known as a writer and lecturer on the subject. His opening remarks are well

worthy of attention. He says: "Forestry has been carried on "in the United Kingdom for many centuries. The main objects, "until quite recently, were the chase, shooting, and landscape "beauty. The economic aspect came more into the foreground "since rents went down, and proprietors had to pay more attention "to the financial aspect of the industry based upon the land. In "bringing about this change, the example of systematic forest "management in India has had a powerful influence. It was "recognised that if systematic economic forestry were to become "an enduring thing in India and in the colonies, it would be "necessary to make it so in the mother country. When forestry "in Britain has once become an essential part of the industry "based upon the soil, those who go out to govern the British "possessions beyond the seas will be duly impressed with its "importance."

Dr Schlich has divided the subject into four sections, the first of which discusses "the importance of the forestry problem "to the nation." After touching on the æsthetic effects of forests, and their influence on the beauty of the country; on their effect upon climate chiefly as shelter from strong winds, for in Great Britain happily their effect upon rainfall is not a matter of importance; and on their effect upon the stability of the soil in preventing erosion, landslips, the silting up of rivers, the damage done by shifting sands, etc., he proceeds to discuss their produce. The home production of timber, probably, does not exceed two million tons, while we import from abroad rather more than ten million tons, the amount increasing annually at the rate of about 332,000 tons. For the timber we import we pay yearly nearly 26 million pounds, of which about 19 millions go to countries outside the empire. The supply from such countries is diminishing, for shortly even those who now send timber to us may have to keep it for their own use. Dr Schlich draws the conclusion that an increase in the woodlands of this country, by the afforestation of waste land, is imperative, in order to keep the money in the country, provide labour for unemployed persons, and cause the development of those industries which use wood as their raw material.

In his second section he discusses the measures which he considers should be taken in this country to ensure the benefits offered by forestry, and in his third he gives his recommendations on the afforestation of surplus lands, with a full discussion. This is an

important chapter, especially as the financial aspect of the question is very fully gone into. Then comes "Notes on Some Types of British Woodlands," and the first part of these notes discusses the management of woods as game preserves, and shows how easy it is to adapt the management of woods, under a proper system, so as to ensure a full head of game, while at the same time they give an adequate return of revenue from their produce. He advises treating pheasant preserves in "coppice-with-standards," and describes fully, by means of an example, what should be done to ensure proper working of the forests, and as little interference as possible with the rearing of the birds and the annual shooting.

A chapter on the conversion of coppice-woods into high-forest deserves an attentive study by numbers of the landowners of England, whose treatment of their woods, whether or not they are required as game preserves, scarcely ever goes beyond a miserable growth of coppice, with a number of standards of more or less decrepit aspect, with short boles and rounded heads covering much ground. A good many foresters would differ from Dr Schlich in recommending coppice-with-standards as the best treatment for game preserves; in their opinion equally good results would be obtained by a treatment in high-forest, for the system of working applied to the high-forest may be so arranged that only small areas are at any time without a thick undergrowth. To make the conversion of coppice-woods into high-forest, Dr Schlich advises as follows: "As soon as the "coppice in any section has been cut, it should be interplanted "with suitable timber-trees (vigorous plants with a well-developed "root-system planted in pits, and none of that barbarous system "called notching, under which the roots are all pushed to one "side!), the plants being placed between the stools. They will "grow up with the fresh stool-shoots, the latter providing shelter "to the soil and drawing the seedling plants up—and so on." This is excellent for simple coppice, but we are not told how the standards in coppice-with-standards are to be treated. Presumably they will be removed, and in most cases this is likely to be the best procedure. The use of coniferous trees for the planting is chiefly recommended; but in many localities it will perhaps be better to use good hardwood trees like oak and ash. And this brings us to Dr Schlich's last and most interesting note on the production of high-class oak, ash, and larch

timber, and this chapter may be confidently recommended for careful study. In the growth of high-forest of oak, he recommends a pure growth in the first instance. Then, at about forty years of age, somewhat heavy thinnings should precede an underplanting with beech, leading in the end to a mature crop of oak and beech, in which the former is about fifty years older than the latter, which is as it should be. In some cases, Dr Schlich says, silver fir is to be recommended for underplanting instead of beech.

The question of how best to grow larch is discussed, but the growing of pure larch is dismissed as a dangerous practice, because, if disease breaks out, it will rapidly spread over the whole wood. And therefore an auxiliary species is recommended, and beech is the tree chosen. How to treat pure larch which has developed disease is the next question considered; and here, too, it is recommended to cut out the diseased larch and underplant with beech, or, in some cases, with silver fir, spruce, or Douglas fir. Finally, an interesting fact is mentioned, that on the Continent Scotch pine is sometimes treated by underplanting it with beech. This is interesting, and the excellent photograph by Mr R. E. Marsden shows that it has been done, but it would have been interesting to know what preparation, if any, was given to the soil. The soil, in pure Scotch pine woods, is apt to get dry and to become sour with the acids developed in the needles. To underplant with beech successfully, we presume therefore that the soil has to be broken up. How is this done?

The Summary with which the author ends his book points out that only India has satisfactorily grappled with the question; that a few of the colonies have done something, but that it remains for Australia and Canada to follow and to save the empire from the reproach of neglecting its forests and their potential capabilities. And, above all, forestry must be made to take, in the United Kingdom itself, a proper position, as far as possible analogous to that which it holds in neighbouring countries, and especially in France and Germany.

4. The Treatment of Timber Crops up to Middle Age, more especially with reference to Mixed Woods.

By "T."

Of late I have observed various statements with reference to the above subject; and having had a long experience in the management of mixed woods and plantations, I am glad to have the opportunity to state some of the deductions which I have drawn from that experience, whether they be in accordance with the recognised theoretical teaching of the present day or not.

Recently it was stated by a lecturer on forestry in one of our English universities, that the teaching of the old school of Scottish foresters, as to the thinning of woods, related to the welfare of the individual trees rather than to that of the wood as a whole. I should myself prefer to put it, that the welfare of the wood is best attained by the careful treatment and development of the individual trees. On that principle I have acted for forty years, and, I think, with success.

So far as my own views of the matter go, the heading of this note is a misnomer. There should be no middle age in well-managed mixed deciduous woods. A beginning there must be; but the end should be such a remote contingency as practically not to be taken into account in considering their duration. Their motto ought to be—

> "Men may come, and men may go,
> But I go on for ever."

Let anyone go into a large city at a busy time of the day, when men are hurrying to and fro, and take note of the size and build of those passing along, and he will at once be struck by their diversity. The same thing is found in all animals of the same species. With these facts in his mind, let him inspect any plantation of a given age, taking note more especially of the length and girth of the various trees, and he must inevitably arrive at the conclusion that there is no such thing as a standard of equality in the units which go to make up any community in the animal or vegetable kingdoms. Upon this premise I considered I had a safe foundation for the system of management I

adopted; and this brings me back to a point I wish particularly to emphasise, viz., that the teaching of our predecessors in Scottish forestry was not far wrong, and that there is not, and never has been, a good foundation for the wholesale denunciation of British forestry, which of late years it has been the custom for certain people to indulge in. The system I adopted may be described as a combination of thinning and regenerating in perpetuity. Thinning sparingly and frequently is my rule. I am fortunate in living in a district with a fair demand for all kinds of timber, large and small. Sometimes there is a good demand for one kind; sometimes for another. I endeavour to take advantage of this as far as possible, as it is important in the pecuniary interests of the owner of the woods. Prices in my experience have varied 130 per cent., and the prices of to-day are a long way under high-water mark. In the early years of a plantation's existence, it is sometimes necessary to take out those kinds which are of little value, in the interest of those which are to remain; and I never hesitate to do this, as the main reason for thinning young plantations is that the majority which remain may benefit.

I am not writing an article on *Thinning*, and I therefore offer no remarks on my method of doing the work; I only state that at this period of a plantation's existence, when the trees come into leaf after a judicious thinning, the canopy ought to be complete, and no question of undergrowth or underplanting should arise. Some woods I have thinned every six years; others I have thinned at varying intervals up to ten years. At each operation, the question as to whether it will pay best then, or at some future period, to cut down individual trees arises. The trees having now attained a considerable size, when thinning takes place a gap in the overhead covering will be produced, and now is the time to encourage the growth of the naturally-sown seedlings, or, if there are none of these, to plant young trees in all the open places. In my own case this cannot be done without protection from rabbits. It must be borne in mind that I am not writing of conditions which are ideally the best for planting operations, but of those where the rabbit has privileges which cannot be gainsaid. I will not state here what means I took to checkmate Mr Bunny; but suffice it to say I did manage it after many failures. In this district, sycamore seedlings come up well in many woods, and I have taken

advantage of these for regeneration purposes in all cases, and nothing, unless it be ash, pays us better. As time goes on, we strive to have trees in all stages of growth.

I trust in these few remarks I have made clear the system I have practised. The main point to be careful about is not to thin more severely than the woods are able to make up for between the periodical thinnings. Otherwise one would be living on capital, and would soon come to grief.

[The system above described appears to follow more or less the general idea of that known as the "selection" system, which is recognised by modern sylviculturists as applicable in the case of some species when grown under certain conditions. Discussion is invited as to the advantages and disadvantages of applying the author's method generally.—HON. ED.]

5. Training in Sylviculture.[1]

By R. C. Munro Ferguson, M.P.

The outlook for British sylviculture has been dreary enough, both as regards private mismanagement, administration, inaction, and public ignorance. Such public interest as is exhibited in tree-culture is so much crackling of thorns under the pot, for it amounts to little else than amiable projects for turning unemployables into foresters, the public having conceived the idea that forestry is an unskilled employment, consisting of carting and wood chopping, and that the preliminary production of timber is some natural process with which science and capital have little to do. Government has made no effort to grapple with the question, and given neither guidance nor example, consequently we have throughout the world an unrivalled reputation for forest destruction and sylvicultural incompetence.

In the United Kingdom there is little work worth recording if we except the production in limited quantity of beech and larch, of oak and ash of great durability, while we have had conspicuous success in the acclimatisation of several Coniferæ of much prospective value.

In the outlying empire, we find in India one notable exception to our rule of failure; there the forest department, organised by distinguished German experts, is administered by the school of British officers which they formed, and there the timber-revenue makes a notable figure in the Indian Budget.

We have, it is true, made some effort of late years throughout the empire to improve our standards, to check waste in Canada and Australia, to plant methodically at home and in South Africa. The same movement is more apparent in the United States, where, if late in coming, it makes rapid progress. Here at home we begin to feel the stimulus of such institutions as the Arboricultural Societies, of the awaking to responsibility recently manifested at the Office of Woods and Forests, of the efforts of several lecturers at educational centres, and of some object-lessons in sylviculture created by private enterprise. A few students have been trained abroad, and a few working-plans are in operation, but neither the supply of trained foresters nor the

[1] Paper read at Society's Forestry Exhibition in connection with Highland and Agricultural Society's Show at Peebles, 20th July 1906.

demand for them is at all commensurate with our present requirements. Moreover, our object should be far wider than that of effecting some improvement over some proportion of existing British woodlands, which is all that can at best be achieved by detached or unsystematic effort. Our purpose, as it affects the United Kingdom, becomes clear when it is realised that the most obvious way to arrest rural depopulation in these islands is not only to make our private woodlands remunerative, but to afforest several million acres of waste and rough pasture, thus giving employment to a great body of people through sylvicultural operations and the great subsidiary industries of which the raw material is timber.

Something may doubtless be done in certain districts to provide for a denser population through the development of intensive cultivation on small holdings, but such areas are relatively minute and the population affected comparatively small; and while the State can achieve comparatively little in the agricultural sphere, save by educational methods, it alone is the creative agency for adequate afforestation.

Yet if we are to have real commercial sylviculture, the first requirement is the trained forester, and our Government, as in other civilised States, should, before all things, take the essential step of providing for the training of our foresters. The only answer to the artistic or philanthropic tree-planters, whose cries are worthy of any flock of gulls, is to make a practical beginning with the foundation stone of knowledge. The only advice to be offered, whether by the expert with his infallible thesis, or by the landowner with his unfailing disappointments, is that a wider diffusion of specialised knowledge must precede any normal or abnormal development or expansion of the forest area.

The forest school, with its auxiliaries, has been the ideal of every British sylviculturist who chanced to appear in the nineteenth century; and, with the opening of the twentieth, material for an educational policy was sifted, collected, and laid down by a Departmental Committee in 1902.

The proposals then made have, a few cranks apart, secured the adhesion of the expert and of such lay opinion as was worth having. Upon our administrative departments, it is true, the report fell flat; within those august precincts it remained so entirely unknown that at the opening of this session one of the Cabinet proposed to "inquire" again into Forestry, coupling with

it what he conceived to be the congenial topic of Coast Erosion. He had got the length, thanks perhaps to the *entente cordiale*, of hearing of an "*Administration des Eaux et Fôrets*," and was therefore assured that these two things, taken together, would spontaneously furnish employment to the troublesome unemployed on land or on water—fresh or salt. This was at least a departure betokening the zeal so conspicuously absent in the two or three departments really responsible, whose normal state of mind is that in Sylviculture, as with the rest, private initiative and enterprise are amply sufficient to meet any exigency. The doctrine of *laissez faire* in all its purity remains at the Treasury, the nearest approach to anything sacred. Yet it is plain enough, apart from any comparison so odious as one between the condition of our own and that of Continental forests, that the simple individualism which can cope more or less with agricultural operations begun, continued, and ended in 100 days, is calculated unreservedly to fail in a sylvicultural project extending continuously over 100 years. It is sufficiently clear that this Government, like its predecessors, approaches the whole subject either with indifference or from the wrong point of view.

On account of recent movements, proposals, and tendencies, a representative body of sylviculturists recently interviewed the Chancellor of the Exchequer to enforce the need for definite action on the lines of the 1902 Report, and a sufficient précis of these proceedings was published. As regards provision for sylvicultural training, it was indicated by the deputation that existing lectureships, some of which should be chairs of forestry, must be properly equipped with, for example, experimental plots or a forest garden, and, when practicable, with a demonstration forest, all under the control of the lecturer, as has been happily accomplished through the transference of the management of a Crown woodland to the Durham College. A moderate provision of this kind for the three kingdoms and Wales might work out roughly at £50,000.

Beyond this substantial instalment for local needs, we require to complete the system—three forest schools, both for home and imperial policy. Avondale, under its Irish Board, should suit Ireland admirably. The Forest of Dean could be advantageously transferred to the directorship of an English school. A forest has to be bought for Scotland and the north of England. For

this the buyer should be able to draw on £100,000, so as to have the option of buying a whole estate, parts of which could perhaps be resold. No doubt 10,000 to 20,000 acres can be got for less than £100,000, for two well-wooded estates, of from 30,000 to 40,000 acres each, of which large portions could have been properly afforested, and the more valuable portions resold, have recently changed hands in Ross and Sutherland.

The Government should further be prepared for an expenditure for some years of several thousand pounds for equipment, all outlays being amply repaid eventually out of forest revenue.

Why, it may be said, should the State find the whole cost for this one branch of technical education? It is because these forest schools, chairs, and lectureships are preparatory steps to enable the State to undertake effectively the repopulation of deserted landward districts. Private owners can afford to do but little for education; it will take them all their time, even with the aid of trained foresters, to put their own woods in order. Moreover, State training in sylviculture does not aim merely at renovating British woodlands, but at enabling the State to double and triple their area, and to lay the foundation of most valuable home industries—lost for lack of the administrative faculty and of the element of continuous good management in the growth of the necessary raw material.

It is to provide, further, British officers and foresters for the empire at large, whose first step as students, if they now desire to acquire knowledge, is to leave their own country, where they can learn nothing by object-lessons.

It is, in fact, not through individual but through State initiative that sylvicultural training is to be established, and adequate object-lessons placed before the eyes of a race that remains ignorant of the most elementary principles of sylviculture. And thus it is that a great branch of rural economy, the feeder of many industries, placed on a footing of common-sense and prudence, will become capable of natural expansion and of effecting wide-reaching social and economic results.

6. Note on *Larix leptolepis* grown in Japan.

By K. Kumé, Chief of the Imperial Bureau of Forestry, Tokio.

This timber-tree grows naturally in pure woods, or in mixture with other species, deciduous and coniferous, in Alpine localities, in the central mountain ranges of volcanic districts in our principal island, Honshin, especially on Mt. Fuji, Mt. Nantai (near Nikko), Mt. Asama (near Karinzawa), and mountains in the county of Shinano.

The typical natural woods occur on Mt. Fuji, about 5000 to 6000 feet above sea-level, and these consist of pure crops of trees with well-developed stems. On the plateau near Mt. Asama, where the soil is chiefly composed of volcanic dust, this timber-tree is cultivated successfully over a very extensive area, the State forests alone covering over 24,507 acres.

The growth in height of this tree is very fast, especially in its younger period, as the following Table will show:—

YIELD TABLE.

Age, Years.	Mean Basal Diameter, Feet.			Mean Height, Feet.			Stem Volume per Acre, Standard Cubic Feet.		
	Quality			Quality			Quality		
	I.	II.	III.	I.	II.	III.	I.	II.	III.
10	0·30	0·20	0·15	40	30	20	982	490	245
20	0·48	0·37	0·29	58	50	40	2450	1470	735
30	0·61	0·50	0·40	68	60	52	3920	2700	1470
40	0·71	0·62	0·50	75	69	60	5490	3680	1960
50	0·79	0·68	0·58	83	75	65	6370	4410	2700
60	0·86	0·77	0·66	87	80	71	7110	4900	3190
70	0·93	0·83	0·73	92	84	85	7740	5400	3580
80	0·97	0·86	0·79	95	86	79	8290	5780	3820
90	1·00	0·93	0·84	98	90	82	8580	6080	4130
100	1·04	0·96	0·87	100	92	84	8860	6330	4210

This Table is constructed from very few materials collected from the last-mentioned cultivated woods.

The best quality of timber is produced on somewhat fresh deep soil formed from volcanic dust. The tree prefers a rather high elevation (over 3000 feet above sea-level) and a cold climate. The seed, which ripens in autumn, is usually obtained from trees about 60 to 100 years old, the quantity sown being

0·8 lbs. per square yard. The growth of the seedlings is about 4 inches in the first year; but by the end of the second year they reach about 1 foot 5 inches in height, and are sometimes then planted out into the woods. The first year's seedlings should be kept in moderate shade during summer, and in the spring of the second year they should be transplanted.

The timber is strong and resinous, is somewhat hard, and is durable in contact with the soil and moisture. It has a well-developed heartwood, is easily worked, and is used chiefly for railway sleepers, posts for fences, telegraph poles, shingles for roofing, the outer finishing of house-buildings, and earth-works.

Air-dried, the specific gravity of the wood is 0·52, and absolutely dry it is 0·47.

7. On Preparing Working-Plans for British Woodlands.[1]

By JOHN NISBET, D.Œc.

Without rendering oneself liable to a charge of being fanatically keen on regularity, order, method and management, one may perhaps venture to suggest that more of systematic and far-seeing future co-ordination of work than usually obtains might well be adopted in the treatment of the woodlands on large English estates, where the woods and plantations often aggregate between 500 and 1000 acres.

Perhaps I may be wrong; but, from what I have understood from conversations with land-agents during the last few years, it seems now to be admitted that, from one cause or another—and, in fact, generally from a combination of causes—the woodlands must be regarded as perhaps not being worked to the best advantage. Many a land-agent knows quite well what ought to be done in the way of first steps to bring the woods and plantations into better order as income-producing portions of estates; and many more know that all is not so well as it ought to be—without, perhaps, being quite able to see clearly what had best be done with regard to the slow process of improvement.

But in either case, however clear or however dubious may be the land-agent's purview concerning the wooded portions of the estates in his charge, I think it is almost self-evident that the best first step to take is to formulate some carefully-thought-out plan for the systematic working of the woods during, say, the next ten years. It need not be any elaborate scheme of management—indeed, I will go further and say that, so long as it helps in achieving (even if only partially) the objects aimed at, the simpler and the less hampered with unnecessary details any such scheme of management is, the better will it be for practical use, the easier will it be understood by all concerned, the more likely is the forester to give it cordial support, and the easier can it be adhered to from year to year, when once it has been approved and brought into use.

And who should draw up such a working-plan? Most certainly, the agent in charge of the estate—if he can find time to do so. There can be not the slightest doubt about that. He ought to

[1] Reprinted from the *Journal of the Land Agents' Society*, by permission of the Editor.

know the woods in his charge better than any other official on the estate, except the forester; and from long acquaintance with them, and frequent visits at all times of the year, he should be in a far better position than anyone else to draw up a sound and rational working-plan for any given period in advance, for in this he can also utilise with advantage his intimate personal knowledge concerning the tendency of local demand, the rise and fall in the market, and the prices paid for the different kinds of woodland produce. No professor of forestry, or so-called "expert," no matter how much of the alphabet he may be able to hieroglyph after his name in representation of university degrees and diplomas of examining boards, can possibly, in visiting any wood or plantation on one single occasion, obtain so correct an idea of the whole of it as ought to be possessed by the thoroughly qualified land-agent who has visited it time after time, and has become intimately acquainted with every portion of it.

But can the land-agent in charge of a large estate find the time that is required to collect all the data needed, and to draw up a well-considered scheme of management for the woods and plantations in his charge? That is a question I cannot attempt to answer. No doubt any exceptionally energetic land-agent will manage to find the necessary time if he really makes up his mind that such a working-plan is desirable, and that he intends to frame one.

It may perhaps, however, convey some useful information on the subject if I give the details of the labour incurred in drawing up a very simple working-plan (which I have just completed) for 900 acres of woods and plantations situated in the west of England. These woods consist of comparatively small areas, usually varying from 4 up to 30 acres in extent, and widely scattered over the different sections of an estate extending into three counties. The woodlands themselves are at present classifiable as follows:—

	Acres.
A—Ash-coppices (with a few standards), . .	54
B—Oak copsewoods, with oak, ash and hazel underwood, and numerous standards, .	446
C—Broad-leaved highwoods, . . .	163
D—Conifer highwoods, ...	192
E—Excluded miscellaneous woods, mostly ornamental or wind-screens, . . .	43
Total, . .	898

The work connected with the formation of the working-plan consisted of (1) drawing up a complete register of the woods according to past methods of treatment, and making preliminary inquiries connected with past working and local conditions; (2) inspecting the woods and drawing up detailed crop-descriptions on the spot, the entries being at once recorded in the "field-book"; (3) framing the future scheme of management after such preliminary investigations, and drawing up the working-plan report, and colouring the maps to accompany it.

The actual work and time required were as follows:—

	Days.
1. Preliminary work in estate office, . . .	3
2. Field-work and crop-description, . . .	11
3. Making working-plan, writing report, and preparing maps, ...	4
Total, . .	18

Now, eighteen working days mean exactly three weeks, and that seems a long time for the preparation of a simple scheme of management for 900 acres of woodlands. But field-work and crop-description must necessarily be slow when the woods are small and scattered. To show the amount of work involved, I kept a careful record from day to day, which gives the following result:—

August.	Number of Hours engaged in Out-door Work.	Woods Visited and Described.	Total.
		Acres.	Acres.
Mon. 20	10	41	41
Tues. 21	9	127	168
Wed. 22	8½	90	258
Thur. 23	8½	56	314
Fri. 24	9	127	441
Sat. 25	5	54	495
*	*	*	*
Mon. 27	10	142	637
Tues. 28	9½	78	715
Wed. 29	7	51	766
Thur. 30	11	50	816

Note.—This gives an average of only 81½ acres a day, although we had exceptionally favourable weather; but, under ordinary circumstances, one should be able to do about 100 acres per diem during good weather.

This outdoor work is indispensable. No matter how well any agent may know the woods, for the purposes of framing a working-plan notes made actually in the woods, with the given conditions straight in front of him, are far more accurate and far more valuable than jottings made in office or in his study. The former are precise and reliable, the latter never can carry the same weight even to the person who has noted them down. This sort of crop-description, and the notes about the future treatment that seems advisable, can best be done by the agent and the forester working in the mornings, because one gets very tired of this kind of thing if one is at it all day long, and work after lunch (be this ever so frugal) is never so good as in the forepart of the day, while one is still fresh and unfagged.

There is, however, another side to the question. I have said that the agent is certainly the man who should be best qualified to do this particular branch of work on the estate entrusted to him. But has the land-agent usually had a thorough training in practical work of this specific kind? I will not risk making any further remark on this point than merely to state that those agents whom I happen to know intimately do not profess to be anything like so well up in this branch of estate management as in most others. Of course "forestry" forms a part in the curriculum of every agricultural college nowadays, and an examination in it is usually passed before a student obtains a B.Sc. degree in agriculture at any university, or the diploma of the Surveyors' Institution; but there is a vast difference between scoring a pass under such tests and feeling thoroughly at home in practical forestry. And this is all the more the case, seeing that British forestry, as practised on private estates throughout England, is something entirely different from sylviculture or timber-growing on an extensive scale, as practised on the Continent. This continental or sylvicultural method is what is generally taught in our schools and colleges, and it has recently been initiated in the Forest of Dean. But it must be recollected that this is probably by very far the largest block of woodland in the United Kingdom; and it also happens to be a Crown appanage, and is therefore not affected by any of the peculiarities and disadvantages to which private properties are subjected with regard to the growth, utilisation, and

regeneration of timber-crops. Hence, even though the land-agent has studied forestry, this does not necessarily mean that he has specialised in this branch; and, unless based upon the practical knowledge gained from specialising and from actual work in the woods, a purely theoretical working-plan would be of little use for practical purposes.

In his student days the land-agent has (in addition to agriculture) to study chemistry, veterinary surgery, and the law of landlord and tenant. In fact, a sound theoretical and practical knowledge of these cognate subjects is at least as necessary as, and often really more important to him than an acquaintance with forestry. Without a fair knowledge of these, no man can be considered well-equipped for the work of estate management. But does the prudent agent, on that account, dispense with the occasional services of the agricultural chemist, the veterinary surgeon, or the solicitor? No, certainly not; and anyone who did so would probably be held to be a very rash person, inconsiderate alike of his own reputation and of his employer's interests. And yet the mistakes that can easily be made owing to want of proper management and of proper action with regard to the woods and plantations may (as these investments grow at compound interest into a large capital in the course of time) in the long run prove far more important from a pecuniary point of view than would be the errors made by injudicious treatment of cattle disease, or by faults in drawing up leases. But there is the one great difference, that mistakes of this latter kind make themselves painfully apparent at once, and become much talked of, whereas faults committed in the silent woods and in the young plantations do not cry aloud to all men; they may remain unnoticed and unknown, and are very often entirely unsuspected even by those who have caused them.

I may be wrong, but it seems to me that this great still silence of the often mismanaged woodlands is probably the main reason why a land-agent feels completely sure of managing his woodlands well, when he will at the same time shrink from taking into his own hands the treatment of sick cattle or the drafting of leases and covenants often really affecting much smaller sums of money than are represented by the woods and plantations.

In every part of the United Kingdom there are now men who have specialised in British forestry, and who practise in the preparation of working-plans; and their occasional help should be as valuable to the land-agent as is that of the veterinary surgeon or the estate solicitor.

To endeavour to give point to the above suggestion, one might perhaps be expected to furnish specific examples of expensive errors, which might have been avoided under competent advice. But that is a thorny path, which craves wary walking, and I have no desire to wander in that direction.

8. Working-Plan, 1905 to 1919, of the Castle Hill Woodlands.

By FRASER STORY, University College of North Wales, Bangor.

This is a Provisional Working-Plan designed to regulate the management of the North Devon woods of the Right Honourable Earl Fortescue for the fifteen years from 1905 to 1919. It is a most welcome addition to the slowly increasing number of British working-plans. It is a strange reflection upon our forestry methods, that until some ten years ago, systematic forest plans were unknown in this country. Even yet only about half a dozen working-plans are actually in operation.

Of plans that have been published in the *Transactions* of the Scottish Arboricultural Society, the first to appear was the scheme of management for the Pit-Wood Working Circle at Raith. This was drawn up for Mr Munro Ferguson's woods in Fifeshire, and is given in the *Transactions* for 1898 (Vol. XV. p. 223). In the following year a plan for Novar woods was prepared, and appeared in the *Transactions* (Vol. XVI. p. 25). In 1900 was issued Dr Nisbet's working-plan for the woods belonging to Lord Selborne in Hampshire, and early in the present year (1906) appeared a scheme for the treatment of the Alice Holt Forest by Dr W. Schlich (see *Transactions*, Vol. XIX. p. 83). Among working-plans of importance that have not found their way into our Society's record of proceedings are those for the Forest of Dean and High Meadow Woods, by the late Mr H. C. Hill. These plans were prepared and printed in 1897. In addition to the working-plans noted above, are one or two which have not been published; still, it must be admitted that the drawing out of schemes of management is not making rapid progress. On this account the present report, by Professor W. R. Fisher, M.A., makes all the more pleasant reading.

The woods on the Castle Hill Estate extend to 1168¾ acres, but as 136½ acres are reserved for ornamental woods, 1032¼ acres only are dealt with in the Plan. Of this area, 463½ acres bear woods of broad-leaved species, while 568¾ acres are occupied by conifers. The principal deciduous trees on the estate are larch, oak (both *Quercus pedunculata* and *Q. sessiliflora*), ash, alder, and hazel. All the commoner

evergreen conifers are present, including spruce, Scots pine, silver fir, Corsican pine and Douglas fir. The glaucous Douglas fir occurs sparsely mixed with other trees. It has thriven well, having attained in forty years a circumference of nearly 8 feet, and a height of 90 feet. This variety, which Professor Fisher states is certainly not the Colorado Douglas fir, grows quicker than larch, but the green or Pacific Douglas fir should be preferred to it. Larch on the estate is somewhat affected by disease, but apparently not to a serious extent: in the future, however, the admixture of other species, particularly beech, is advised. Common alder sells well, and the planting of white alder (*Alnus incana*) is suggested. The author's statement that the timber of the latter is of "somewhat better quality" may perhaps be questioned. Hazel occurs largely in the underwood, and finds a market as spar stakes and for barrel hoops: the association with it of ash is recommended for the future.

All these items of information, and others concerning labour, insect pests, climatic conditions, etc., are interesting, and find their proper place in the general Plan. It is, however, the proposals for future systematic management that we regard as of chief importance. These proposals are embodied in Part III. of the Report. This section commences with the statement that "hitherto the woodlands have been managed without any well-considered system, so that the underwood in most of the broad-leaved woods has not been cut for years. Many large branchy standards are mixed with coniferous trees, and in some cases broad-leaved trees are grown where conifers would thrive, and *vice versa*." Of how many woodlands in Britain might this not be said? To bring these woods into some sort of order is the task which Professor Fisher has set himself.

He proposes to do this, in the case of the broad-leaved woods, by the system of Coppice-with-standards. As underwood is said to be at all times saleable at Castle Hill, an early return from the coppice is assured, and this it is which has led to the choice of the system. Ultimately the underwood will be worked upon a rotation of probably twenty-five years, but in order to bring the existing coppice (nearly all of which is ready for felling) into somewhat better condition, it is proposed to distribute the present fellings over fifteen years. At the end of

that time it will be possible to arrange a better series of Age classes.

As regards the standards, the following proportion per acre is advocated:—

	No. of Trees.
Standards of four rotations,	3
Standards of three rotations,	3
Standards of two rotations,	12
Tellers of one rotation of underwood,	20
Saplings planted after last felling,	50
Total per acre,	88

It is said that this should give about 1000 cubic feet of standards, quarter-girth measure, per acre, when the woods are brought into a normal condition.

Coming to the coniferous woods, no fixed rotation has been prescribed for them at present; but a statement of annual fellings and thinnings has been drawn up, which will regulate these operations for the coming fifteen years. Meanwhile instructions have been given in regard to the species to be planted, and the present irregular condition of the wood will be gradually improved.

As may be imagined, only a rough estimate of the future yield of the woods is possible, but Professor Fisher makes the forecast that the broad-leaved woods may eventually give a gross return of at least 25s. per acre annually, while "the coniferous woods will produce £2, 10s. per acre, giving altogether an income of £2000 per annum." The net profit in the past, taking the average of ten years, has been £762 per annum.

Accompanying the Report are Appendices giving a detailed description of each compartment, together with its proposed future treatment. There are several tables and a list showing the dates when the various woods on the estate were planted.

The whole scheme is thoroughly practical, and provides an excellent example of what a provisional working-plan ought to be.

9. Note on "The Novar System of Combating Larch Disease."

By JOHN NISBET, D.Œc.

As the article which appeared in the *Journal of the Board of Agriculture* for March 1906, dealing with the Novar system of treating larch plantations, has been reproduced in the *Transactions of the Royal Scottish Arboricultural Society* for July 1906, it must be assumed that it has thus been brought before the notice of a great many landowners and land-agents not specially trained in forestry, as well as of foresters whose training has been more technical in this direction and whose daily work also enables them to make a closer and more detailed study of the practical prevalence and effects of the now ubiquitous, dreaded larch disease, and of the conditions most likely to favour its propagation. The appearance of that unsigned article in an official journal has undoubtedly stamped it with official approval; and its whole tone is equally undoubtedly one of warm approval, and of conviction that the "system" therein described is really a practical advance in the direction "of combating larch disease."

Speaking as a forester, however, I question very much if such will ultimately prove to be the case. On the contrary, it seems to me that the continuation of this method, which has already been "for some years practised," is far more likely to perpetuate the larch disease, and to form nurseries or hot-beds of the fungus under circumstances extremely favourable to its growth and development, and to the dissemination of its disease-producing spores. The experience of ten to fifteen years should, however, afford a practical solution of the question; but apparently that has not yet been acquired.

Hence, if I may be permitted to deal with the matter in a manner as little controversial as the subject allows, I shall be glad to be allowed to show here that there is a possibility—and, in my opinion, a very great probability—that the measure will ultimately prove to have exactly the opposite effect of what is intended.

Certainly, if one finds oneself face to face with a 16- to 20-year-old pure larch plantation in which canker has ravaged most or all of the smaller and less vigorous poles, then the best one can do is to thin out all of these, and allow only the healthier and

better-grown to remain as the young timber-crop. This would then, of course, have to be underplanted with whatever kind of shade-enduring tree local experience shows to be most suitable, and likely to be most profitable—just exactly as is done at Novar.

But it is an entirely different matter when one deliberately, and of purpose aforethought, as we say in the North, forms, year by year, *pure* larch plantations at 3½ feet by 3½ feet, with 3556 plants per acre, knowing quite well – and, indeed, expecting—that the vast majority of these are bound to become infected with the canker-producing fungus to such an extent as to plainly exhibit the outward and visible signs of this disease. Now we know, beyond all question of any doubt about the matter, that the formation of *pure* larch plantations is the surest way of exposing them to outbreaks of this disease; and, consequently, *pure* plantations must also be the most direct way of encouraging and fostering the fungus, and of enabling it to fructify and to disseminate its spores.

I could point to larch plantations varying up to over thirty years of age, which I have recently visited in Worcestershire and Gloucestershire, and which were, up to within the last few years, remarkably free from canker; but, with the planting of larch almost pure, even in comparatively small plantations, the result has been a striking increase in the appearance of canker throughout the plantations made within the last fifteen years, as compared with those made from fifteen to thirty years ago. The local conditions are such that it seems to me warrantable to believe that the sources of infection have been spores from the older plantations, even though these were themselves not badly attacked by the fungus. And the risk of increase in cankerous attacks throughout new plantations must, in my opinion, be greater now than it was over fifteen years ago—while, of course, the danger of its occurrence in a permanent epidemic form must increase if large pure plantations be made.

And yet the formation of large pure plantations is, we are told, precisely the step that Mr Munro Ferguson takes, apparently in the belief that it is the best means "of combating larch disease":—

"He now plants pure larch woods, and when the trees are 16 to 20 years old he removes all the stems except the soundest and most promising, of which 300 to 500 are left per acre. Needless to say, the system is inapplicable to cases where all, or practically all, the trees are attacked by disease at this early stage,

but instances of such virulence are, on the whole, of rare occurrence. The trees that are retained are the picked stems of the three to four thousand originally occupying the ground"—*i.e.*, 3½ by 3½ feet = 3556 per acre—"and measure up to 51 feet in height and 4 to 8 inches in diameter at breast-height. Stems that are sound, or fairly sound, at this age are not likely to suffer much from disease in later life."

This does not expressly state, in so many words, that of about 3500 larch originally planted at least 3000 to 3200 are cankered stems; but this is apparently distinctly implied, because the soil-quality being evidently the same (as is shown by the planting of about 3500 per acre in each plantation), Mr Munro Ferguson would probably prefer in all cases to have a crop of 500 sound, non-cankered poles, if he could grow them, rather than one of 300 poles only. And this means that from over 85 to nearly 90 per cent. of the larch planted become attacked with the disease to such an extent as to show cankerous wounds, from each of which the fungus-fruits formed tend to perpetuate the disease, and to increase its prevalence by emitting countless myriads of spores ready to germinate under favourable circumstances—*one of the most favourable of these latter being, in our damp climate, the formation of pure larch woods.*

And while it is true that stems which are clean and sound in the bole at 16 or 20 years of age are not likely to show canker-wounds later on in the lower part of the stem, it does not at all follow that they will not suffer from canker in the crown, as has been found from experience to have been the case during the last twenty-five years in Ireland, before which time the larch disease was almost or quite unknown, but where it has now become as prevalent and as destructive as in any part of Britain.

Hence even the soundest 300 to 500 stems of such pure larch plantations are exceedingly likely to become cankered in the crown subsequently, and in due time to become also the further means of propagating and disseminating the disease-producing spores.

Would it not perhaps be a better plan to try and combat the larch disease by planting, as the bulk of the crop, the shade-enduring conifers named as suitable for underplanting, and at the same time interplanting them with stout healthy larch, either set singly or in small groups, to the number of about 430 to 650 per acre, *i.e.*, from 8 to 10 feet apart? This would give

them the best environment for their protection against disease, though even then canker could hardly be hoped to be exterminated locally. But it would certainly be more likely to combat the disease than is the system of planting pure larch thickly, as now practised. It would, of course, probably necessitate very careful thinning—now of larch, now of the other conifers – and the forecast of future revenue might seem less than the present system of pure planting has hitherto actually yielded; but the present returns will hardly continue so favourable if the opinion should prove correct that the Novar system must tend to make the disease more prevalent locally than it already is.

And in conclusion, lest there should be any possibility of doubt about the matter, I would expressly state that the question here raised is not whether "the Novar system" is, or is not, the most profitable for the owner—that is a matter with which I have no concern whatever. That it certainly seems to be the most remunerative is proved by the fact that it has been tried, found successful, and adopted by the landowner as the method likely to bring him in most profit. That merely proves, however, that, under the given local conditions at Novar, it pays better to grow pure crops of diseased larch, of which 90 per cent. have to be cut out as 16- to 20-year-old cankered poles, than to raise clean healthy crops, chiefly formed of other kinds of trees, for which the local demand is not so favourable. But the fact remains, that in acting thus Mr Munro Ferguson seems to me to be deliberately encouraging the spread of the larch-canker disease throughout all the district of which the Novar larch plantations form the central point. That is the important matter about which I would invite discussion.

10. The Large Larch Sawfly (*Nematus Erichsoni*).[1]

(With Coloured Plate.)

By R. STEWART MACDOUGALL, M.A., D.Sc., Honorary Consulting Entomologist to the Society.

The importance of a careful outlook by the sylviculturist and the arboriculturist in order to observe whether or no there seems to be any increase above the normal of a special insect, receives once more strong support in the recent ravages of larch by the caterpillars of the large larch sawfly over a large area in Cumberland. We have in our country native species of forest insects which once and again on the Continent or elsewhere have been the cause of immense loss, and yet in Britain have never attracted attention by any serious damage, or, indeed, by any damage at all. There is always, however, the possibility of danger to our trees from such species, and this danger will grow with the increased area that may be put under forest crops, and with the massing together of great numbers of the trees of one species.

Nematus Erichsoni is not a very common insect in Britain or Europe generally. It is not even mentioned by name in the literature of wood or forest injury in Britain, and it is almost passed over in the Continental forest literature as of little forest importance. The increase, however, of this insect in the last three years over a considerable area in Cumberland, and the damage done by its larvæ there, is a matter of great importance, and may have, unless careful outlook be kept, grave results elsewhere. It were a pity, after the loss and discouragement caused by the larch canker fungus, if a second scourge in the shape of this sawfly enemy should follow. Our foresters should be on the alert against this possibility. The flood comes with a crack in the dyke. The worst insect plagues in forestry have originated in a limited area, and wherever the principle of "resisting the first advances" is neglected, a plague may follow which no man can cure.

Previous History of N. Erichsoni.—There are references in the forest literature of the Continent to the larvæ of the large larch

[1] Reproduced from *The Journal of the Board of Agriculture* for October 1906, by permission of the Controller of His Majesty's Stationery Office.

sawfly as having been the cause of damage to larch in the Harz Mountains, in Holland and in Denmark. The references are chiefly antecedent to 1840; the most recent is from Denmark, in 1902. The insect has been recorded in Western Europe, from Sweden in the north to as far south as France.

As regards Britain, Cameron[1] writes: "*Nematus Erichsoni* does not appear to be a common species. I have only seen a specimen taken by the Rev. T. A. Marshall, of which I do not know the locality. Mr Dale records it from Glanville's Wootton." Mr C. O. Waterhouse, of the British Museum, courteously writes to me: "We have only three examples of *N. Erichsoni* in our British collection, and unfortunately they have no localities. Two are from Cameron's collection, one from J. F. Stephen's collection." Mr F. V. Theobald, in *Nature* of 20th September last, gives as localities, "near Esher, Wye, Great Staughton, and Budleigh Salterton." Completer records would probably show a more extended distribution.

Nematus Erichsoni in America.—In the United States of America this sawfly has been catalogued as one of the most destructive forest insects, the larvæ, in the North-Eastern States, having at different times defoliated the larch. Until about 1882, the insect had not been regarded as troublesome. In a Bulletin published in 1881, *Nematus Erichsoni* was passed over, but in his next Report,[2] Packard told how in late August, in Maine, the caterpillars of this sawfly partially or entirely stripped the American larch or Tamarack (*Larix americana*) over a considerable area of swampy ground where the tree grew, the ability to grow in such a habitat making the tree a valuable one. The attack was continued in neighbouring parts in 1883, when again many trees were stripped and fatally injured. Similar infestation was reported from New Hampshire and Massachusetts. Then in Northern New York an extensive area of European larch was defoliated. Fletcher[3] has recorded enormous damage to larch in the summer of 1884 in and near Quebec by the caterpillars.

Defoliation of Larch in England.—During the past summer

[1] *A Monograph of the British Phylophagous Hymenoptera*, vol. ii. p. 57, 1885.

[2] Fifth Report of the United States Entomological Commission: "Forest Insects," by Packard, 1890.

[3] *Canadian Entomologist*, November 1884.

the caterpillars of *N. Erichsoni* have been at work in very large numbers over a considerable area in Cumberland. The trees cover the mountain up to an elevation of 1600 feet. Part of the area is made up of pure larch, which suffered more than another portion of the wood where the larch is mixed with oak and a few other broad-leaved species. The attack was first observed in 1904; it was more serious with the spread of the insect in 1905; and again in the summer just past great havoc was done. Caterpillars were sent to the Board of Agriculture and Fisheries for determination and report in August of this year, and a visit to the affected district followed.

The worst infested area, known as Dodd Wood, is on Miss Spedding's Merehouse Estate, and is situated about four miles from Keswick, in the Bassenthwaite direction. In shape the Dodd Wood is somewhat conical, hence is exposed to all points of the compass; the largest part, however, faces south. The age of the trees attacked varies from twenty years to seventy years and over, and the fact of tall trees being attacked adds greatly to the difficulty of satisfactorily combating the caterpillars and the adult sawflies. When I visited the place in the last week of August, the brown and withered appearance of many of the trees attested the severity of the infestation. At some hundreds of yards distance, looking up at the wood, the eye could easily pick out the defoliated trees. Some of them were practically in their winter condition, devoid of leaves. Others which had been defoliated in July had by mid-August started to produce new leaves, so that on inspection at the end of August such larches looked as they normally do in April or May, with the dwarf shoots bearing tufts or clusters of partly grown leaves.

Some seventy-year-old larches felled at the end of July and the beginning of August had thousands of the sawfly caterpillars on them. These caterpillars, many of them dislodged by the fall of the tree, made their way to the trees standing near and attempted to ascend them, the bases of the trunks of several hawthorns, for example, being hidden by their numbers. The caterpillars, numerous and easy to find on the trees up to the third week of August, were by the fourth week, in the great majority of cases, full fed, and had left the trees and made their way into the moss and litter on the ground below, in order to make their cocoons. Here and there in such places, on looking

one found many cocoons and some caterpillars which had not yet spun up. I brought away with me abundant material from which I hope next year to clear up points in the biology.

On the 31st of August caterpillars were still to be found on the trees, but only after a very careful search. In addition to well-grown caterpillars, I took on this date very small caterpillars, not more than a few days old. One must not rashly assume that these tiny caterpillars were the result of a second brood of sawflies. There is the possibility that they were from eggs laid by sawflies that had issued from cocoons of 1905, but later in the season than the great majority. This *Nematus* infestation in Cumberland is serious, not only from the loss that it has already occasioned, but also because there are several other large tracts in the neighbourhood planted with larch which are in danger of infestation. There had been the intention too, on the affected estate, to plant another 27 to 30 acres with larch, but this work has had to be held over on account of the presence of the sawfly.

Altogether in this neighbourhood an area of over 300 acres has been attacked. Examination of other larch woods near, and of isolated larches here and there at a greater distance, showed that there were still uninfested places, but the danger of infection is great. That the attack is not limited to the Merehouse Plantation and immediate neighbourhood is seen in a letter to the Board from Mr Smith Hill, saying that since the outbreak at the Dodd Wood he has found cocoons in abundance in Coomb Plantation. Coomb Plantation is on the other side of the Derwent Valley from the Merehouse Plantation. It is situated four miles from Keswick in a north-westerly direction, and lies between 1000 feet and 1500 feet above the sea-level. The plantation is sixty years old, and extends to 200 acres. Mr Smith Hill has also been informed of attack on Shoulthwaite Wood, near Thirlemere Lake.

Position of Nematus Erichsoni in the Insect World.—The large larch sawfly belongs to the order Hymenoptera—an order containing, amongst other insects, the bees, wasps, and ants. The family of Hymenoptera which has the greatest interest for the forester is the *Tenthredinidæ*, or sawflies. The sawflies are so called from the fact that the ovipositor of the female is modified, typically, to form a sawing apparatus, by which the openings are made in leaf or twig for the reception of the eggs. The two saws

are side by side on the under surface at the hind end of the sawfly. The adult sawflies do not attract much notice, but if examined it will be seen that they do not have the narrow waist characteristic of the wasps, but that the base of the abdomen is broadly joined to the thorax. The adults, in nearly every case, are harmless, save that, of course, they lay the eggs. The larvæ are very characteristic: they are caterpillars, with more than sixteen legs (the caterpillars of the genus *Lyda*, troublesome on fruit and forest trees, have eight legs, six in front and a pair behind; and the corn sawfly, *Cephus*, if included under *Tenthredinidæ*, would be another exception), and they feed in the great majority of cases exposed; a few, however, live in galls, or mine or burrow in plant-tissue. Dr Sharp reckons that nearly 400 species have been found in Britain, and amongst these are species troublesome in gardens, and to fruit, and in agriculture. Six or seven genera contain species of importance in forestry, of which *Lophyrus* (see Leaflet 103), *Lyda*, and *Nematus* are the most important.

The species of the genus *Nematus* that have relation to forestry affect, amongst broad-leaved species, the willow chiefly. The interesting, and sometimes injurious, caterpillars of *Nematus septentrionalis*, besides feeding on willow, attack also the leaves of birch, hazel, alder, and mountain ash. On the larch, besides *Nematus Erichsoni*, the large larch sawfly, I notice later, for comparison, *Nematus laricis*, the small larch sawfly.

Description of *Nematus Erichsoni*.

Adult.—The adult sawfly measures up to $\frac{3}{8}$ inch, or a little over, in length, and in spread of wings just less than an inch. The ground colour is black. The head and thorax are black; the first joint of the abdomen is black; then follow joints coloured red; the end of the abdomen again being black. The mouth parts, the two front pairs of legs, except at the part next to the thorax, and the upper parts of the femora of the hind legs, are reddish or reddish-yellow. The tibiæ are yellowish or pale in the upper parts. The antennæ are nine-jointed and somewhat thick, and taper towards the apex. With a lens the head and thorax are seen to be sparsely and finely pubescent, and the thorax is markedly punctured. The wings are glassy and slightly clouded below the stigma.

Egg.—The egg is longish oval, and measures just over a millimetre in length. It is white in colour.

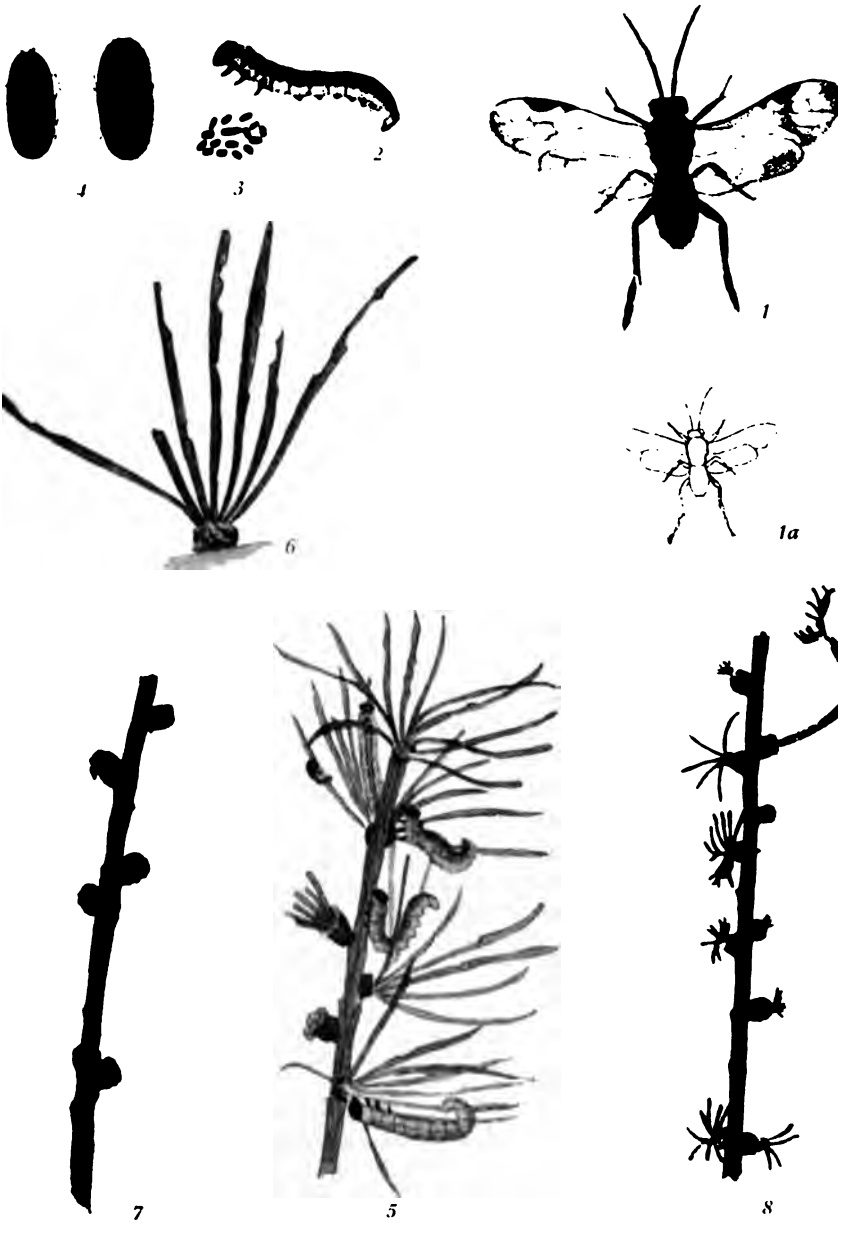
Larva.—The full-grown caterpillar measures three-quarters of an inch, or a little over, in length. It has a round black hairy head, with a single ocellus on each side. On the upper surface, all down the back, the colour is grey-green; the sides are lighter; the under surface is yellowish-green. If one uses a lens there will be seen on the abdominal segments transverse rows of minute warts with spines. The spiracles along each side are brown. The legs number twenty, viz., three pairs of thoracic legs, which are black, and seven pairs of abdominal legs, which have the colour of the underside of the body. The head is followed by twelve segments or joints—1, 2 and 3 are thoracic joints, and each bears a pair of legs; 4 to 12 inclusive are abdominal joints; 4 has no legs; 5, 6, 7, 8, 9 and 10 have each a pair of legs; 11 has no legs; and 12, the last joint, carries a pair of legs.

Packard[1] describes the caterpillar as moulting three times, and so distinguishes four stages of larva. On hatching, the head is very large and dusky green, not black; neither are the thoracic legs black; the body is uniformly pale green. After the first moult the head and thoracic legs are black; the body is wrinkled, but no warts show. After the second moult the upper surface is grey-green, and the transverse rows of warts appear. The caterpillar attains its full size after the third moult. The moulted skins can be seen wound round or attached to the leaves.

Excrement.—The castings (excrement) of the caterpillar are longish, cylindrical, and somewhat square cut at the ends. The castings observed on the ground will afford a hint as to the presence of the larvæ. So numerous were the caterpillars in some parts of the attacked area, that in July their excrement falling on leaves below suggested the patter of rain drops.

Cocoon. The cocoon, strong and leathery or parchment-like, is dark brown in colour; it is cylindrical in shape, with rounded ends; the inside is smooth, the outside shows a raised network pattern. The size may be taken on the average as between $\frac{3}{8}$ inch and $\frac{1}{2}$ inch. I have some from the soil less than $\frac{3}{8}$ inch, but these may contain parasitized larvæ.

[1] Fifth Report of the United States Entomological Commission: "Forest Insects," 1890.



THE LARGE LARCH SAWFLY.
(Nematus Erichsoni.)

In answer to inquiries I give below Tables which may assist in making certain the determination of the large larch sawfly.

Moth Caterpillars.	Sawfly Caterpillars.
Head somewhat hollowed out and not so globular.	Head globular.
A group of ocelli on each side of the head.	One ocellus on each side of the head.
Hooklets on the abdominal legs.	No hooklets on the abdominal legs.
Legs 16 in number or less.	Legs more than 16.
The Geometer moth caterpillars, of which at least three species feed on larch, have a less number of legs than 16. The caterpillars of the larch mining moth (this was quite common in Cumberland, and is often a serious enemy of the larch) mine into the needles, causing the upper half to shrivel up; these caterpillars are very minute, and make cases for themselves in hollowed out parts of the needles.	Genus *Lophyrus*. *e.g.*, the pine sawflies, not found on larch. The caterpillars have 22 legs.
	Genus *Nematus*. The caterpillars have 20 legs.

The Large Larch Sawfly (*Nematus Erichsoni*).	The Small Larch Sawfly (*Nematus laricis*).
Adult 10 mm. in length, and with red on the abdomen.	Adult 6 mm. in length, and quite black.
Thorax prominently and thickly punctured.	Thorax not prominently punctured, and may be quite smooth.
The eggs are laid on the young shoots.	The eggs are laid on the buds.
Caterpillar measures up to 22 mm., and is grey-green on the back, lighter on the sides.	Caterpillar measures up to 15 mm., and is grass-green or greenish-brown.
Head of caterpillar black.	Head of caterpillar brown.
Caterpillars eat till the end of August.	Caterpillars full grown in July.
The caterpillar eats especially the leaf clusters or tufts.	The caterpillar eats more commonly the single leaves on the shoot of the current year.

Life-History and Habits of the Large Larch Sawfly.—The caterpillars winter under cover of the cocoons, and pupate, generally speaking, in May or June, according to the conditions. I know of no records in Britain giving dates of the appearance of the adults, but probably they issue in June. The eggs are laid, in one or two rows, on the youngest larch shoots, and in slits in the bark made by the saws. Packard saw the eggs laid at the bases of the young leaves. (It will be recalled that on the new shoot, or shoot of the current year, in the larch the leaves are not in clusters but are arranged singly.) The presence of the eggs may cause the shoots to curl somewhat, and on occasion the leaf at whose base an egg has been laid, dies. Packard[1]

[1] Fifth Report of the United States Entomological Commission: "Forest Insects," 1890.

observed a female in confinement, and thus describes the egg-laying :—"The sawfly stood head downward while engaged in making the puncture, and was not disturbed by our removing the larch twig from the glass jar and holding it in our hand while watching the movement of the ovipositor." (This same restfulness I have observed in the pine sawfly (*L. pini*) while watching a female in captivity laying her eggs.) "The serrated blades of the ovipositor were thrust obliquely into the shoot by a sawing movement. After the incision was sufficiently deep the egg was forced out of the oviduct by an evident expulsive movement of the muscles at the base of the ovipositor. The slit or opening of the incision after the egg has passed into it is quite narrow, and about $1\frac{2}{3}$ mm. in length. While engaged in the process the antennæ are motionless, but immediately after the ovipositor is withdrawn they begin to vibrate actively, the insect being then in search of a site for a fresh incision." As the embryo develops the slits in the shoots gape a little, and through the oval hole the caterpillar creeps on hatching. The caterpillars may begin by gnawing the single leaves on the young shoot, but they soon pass to the clusters of needles on the dwarf shoots. Single leaves may be eaten so that the edges appear serrated, or the clusters of leaves may be half eaten or quite destroyed so that only stumps are left.

In the young condition the caterpillars may be found in clusters. The caterpillars assume various positions, arranged with the tail end curled round the shoot; or like a mark of interrogation, or the letter S; or (a characteristic attitude) with the hind half of the body turned upwards and over the front half. On being handled the caterpillars would wriggle violently, rolling themselves about in a fashion that reminded one of surface caterpillars, and ultimately lying on their side with their body forming a circle, the tail end touching the head.

The larvæ are to be found at work during the summer, and most numerously in July and the first fortnight of August. By the end of August most have left the trees. Some, however, do not complete their growth till September. I kept some in confinement that made their cocoons in the second week of September. The full fed caterpillars leave the trees and pass into the moss or litter or the soil below, and in such shelter-places spin the cocoon in which they pass the winter. They lie somewhat bent in the cocoon until the late spring or summer of

the next year, when they turn to pupæ, the adults issuing in due course.

There is no evidence, so far, that there are two generations in the year, and yet the caterpillars seem to attain full size in a comparatively short time. It is interesting and sometimes puzzling as to why, from cocoons collected and possibly made at the same time and kept in the same conditions, there should be such variations in the escape of the adults. For example, in my recent experiments with *Lophyrus pini*, the pine sawfly, in 1905, from cocoons collected in the winter of 1904 and kept indoors, 117 adults issued, these insects appearing on thirty-seven different days between April and August, the first coming away on April 14th and the last on August 1st. In 1906, from a number of cocoons made by the caterpillars in confinement in 1905, and kept indoors, 104 adults issued, the insects appearing on thirty-two separate days, the earliest on the 1st of June and the last at the end of the first week of August. The practical import of this is that, as egg-laying takes place at different times according to the different flight-times of the adults, infestation must be expected not merely at some limited definite period, but any time during the summer when the temperature is favourable.

Age of Tree Attacked.—Infestation in the larches in Cumberland was upon trees of from twenty to seventy years of age. The records elsewhere show that young plants of ten years of age may be attacked, but attack has been reported more frequently on older and taller trees. In one case in Washington County, United States, larches less than 25 feet high had been spared, but of those of 30 feet and upwards 90 per cent. had been attacked and almost completely defoliated. The fact that the caterpillars work on well-grown trees, and it seems characteristically at the crown first, increases greatly the difficulty of fighting them.

Preventive and Remedial Measures.—1. As against the adults scarcely anything can be done effectively. They lay high up, well out of reach, so that the placing here and there of tarred boards standing erect and with the tar frequently replenished, which is practised sometimes against sawflies that lay on young plants, cannot be tried with hope of success.

2. If young trees chance to be affected with the caterpillars, the caterpillars, especially when they are small and, it may be

in clusters, should be squeezed in a gloved hand or rubbed off the shoots into a small hamper; or badly infested shoots could be snipped off or cut through and dropped into the hamper. The contents of the hamper are then emptied on a slow-burning fire. This measure, practised against the pine sawfly, will often be quite impracticable against the caterpillars of the large larch sawfly, feeding as these do, out of reach.

3. Jarring, so as to shake down larvæ, would meet with most success on a dull day or early in the morning, when the caterpillars are cold and sluggish.

4. Where the caterpillars are out of reach, and the tree attacked is isolated, or where the infestation is limited, the trees should be sprayed with helebore, or Paris green, or arsenate of lead.

5. When infested trees are felled, the dislodged caterpillars should be destroyed.

6. There is a certain amount of help from nature. Birds may take the caterpillars; in the Dodd Wood rooks and jackdaws were seen to be feeding during July on the caterpillars. Parasitic ichneumon flies are active enemies of the caterpillars.

7. The cocoon stage comes within reach of practicable treatment if the infested area be not too wide. The litter and surface soil below trees that were attacked could be ploughed in deeply so as to bury the cocoons, or, in a prescribed area, boys could be employed to collect them, or the soil and litter and moss could be collected together in little heaps. If quicklime were placed on these and water sprinkled over them, the heat engendered would kill the enclosed caterpillars. Swine, useful in some insect infestations against pupæ in the soil, are not employable here, as they refuse to eat the cocoons.

Description of Figures.

Fig. 1. *Nematus Erichsoni* (magnified).
Fig. 1A. *Nematus Erichsoni* (natural size).
Fig. 2. Larva.
Fig. 3. Excrement of larva.
Fig. 4. Two cocoons, each magnified 1½ times.
Fig. 5. Larvæ on twig of larch; on one of the needles a moulted skin is seen.
Fig. 6 Some injured leaves (magnified).
Fig. 7. Larch twig defoliated by the larvæ.
Fig. 8. Larch twig, drawn in September, that had been defoliated and now putting out new leaves.

Figs. 1 and 1A after Packard; all the others drawn from nature.

II. Prevention of Damage by the Pine Weevil (*Hylobius abietis*).

By EWAN S. GRANT, Bakewell, Derby.

When numerous, the pine weevil may be reckoned as one of the worst of insect pests in young plantations of conifers; in fact, it is as destructive in these as the pine beetle is in those of greater age.

To combat this pest with any hope of success, one must possess a thorough knowledge of the habits of the insect and of its life-history. This being mastered, one of the most vulnerable phases of its life-cycle—say, for instance, the feeding or the breeding season—should be singled out, and the principal attack directed against it at this time; if the attack be patiently persevered in, success will be assured. Indeed, it is the case with all insect pests that, when once their life-cycle is clearly understood, some simple means can generally be applied at some period of it by which their numbers can be greatly reduced.

Unfortunately, there is no means of keeping the weevils out of a plantation, and, owing to their strong sense of smell, they will travel long distances, by crawling and flying, to their breeding and feeding grounds. The best method of preventing damage by these noxious insects is, I think, to take advantage of their strong sense of smell, and by this means to trap them. The following is an account of a combat with them, in which I was personally engaged.

Two young plantations, extending to about 8 or 9 acres and about 20 acres respectively, were found to be infested by the weevil, the former during the second and the latter during the first season after planting. A variety of species had been used in the formation of these plantations, namely, Scots pine, larch, *Abies nobilis*, silver fir, Douglas fir, spruce, and Corsican pine; a very small patch of Stone pine had also been planted. In some cases two or three of the species had been planted in mixture, while others formed

small pure groups, separated from each other by rides or drives. Close observation showed that the weevils, about the latter end of April, had commenced their depredations, and very soon they began to appear in alarming numbers. The attack threatened to become serious, for the plants, being so recently planted, had not got thoroughly established, and were not in a fit condition to resist it. Steps were at once taken to trap the insects, and so protect the crops against their ravages.

Bags were filled with fresh pine sawdust, and these and a number of slabs, about 3 feet in length, sawn from fresh pine, were conveyed to the plantations. The slabs were laid out along the rides, and also among the plants, at distances apart of about 30 yards, and beside each slab was laid a small pile of sawdust. The latter was spread out on the ground so as to form a band approximately 3 feet long, 9 inches wide, and about 2 inches deep. The pine slab was then placed, sawn surface downwards, over the sawdust, and in order to facilitate the entrance of the weevils, it was slightly raised at one end by placing a small wooden peg, about 6 inches long, underneath it. The traps should be laid out on some definite plan, so that they may not be overlooked when the examinations are made, and that time may not be wasted in searching for them.[1] It is a good plan to place a little fresh sawdust underneath the slabs once in every three weeks, so that the fresh smell may be maintained. The traps should be examined every morning at a fixed hour, the best time being from 7 to 9 o'clock, as later in the day the weevils leave their refuge for feeding purposes. The weevils may be collected into a wide-mouthed glass bottle, a small wooden peg being used for knocking them into it, and each day's collection should be carefully destroyed. When the pine slab is lifted, the weevils will be found either adhering to its cut surface or on the top of the sawdust.

Below is given the "catch" of weevils in the two plantations. The traps were set in the last week of April, and they were regularly examined every morning until the middle of June,

[1] The position of each trap may be marked by a stick, or small branch, 2 or 3 feet long, stuck into the ground beside it.—HON. ED.

after which it was found that three times a week was sufficient, owing to the small number of weevils remaining.

	Older Plantation (8 to 9 acres).	Younger Plantation (20 acres).
To 28th April, . .	4	17
„ 5th May, . .	144	69
„ 12th May, . .	265	73
„ 19th May, . .	437	38
„ 26th May, . .	278	133
„ 2nd June, . .	134	53
„ 9th June, . .	115	65
„ 16th June, . .	64	29
„ 23rd June, . .	18	8
„ 30th June, . .	12	7
„ 7th July, . .	1	0
Totals, . .	1472	492

On wet or damp days the weevils frequented the traps in greater numbers, and they remained in a semi-dormant condition. On bright mornings they betake themselves earlier to the plants, and when this is the case it will pay to spend say a couple of hours, after the traps have been gone over, in hand picking them from the plants; and I may say that occasionally I considerably augmented my catch by this means, as many as three being sometimes picked from one plant. Great care must, however, be exercised when picking the weevils from the plants with the hand. If the plant be roughly taken hold of, or in the least shaken, the weevils at once draw back their antennæ alongside the proboscis, draw their legs up underneath their bodies, and drop to the ground. When on the ground they remain quite motionless, as if dead, and as their colour corresponds closely with that of the soil it is a difficult matter to detect them.

In the vicinity of plantations infested with weevils, wagtails should be preserved, and encouraged as much as possible, as they greedily devour these insects, picking them off the plants and eating out their insides.

About the end of June the weevils begin to desert their feeding-grounds in search of a suitable breeding-place.[1] I may mention that during the season in which I was engaged in trapping the weevils I had to strip the bark off some large Scots pine trees, for the purpose of destroying the larvæ of the pine beetle, and when the trees were turned over I invariably found a number of weevils adhering to the bark. Possibly these weevils were on the lookout for a breeding-place, and it is also quite possible that they had migrated from the plantations where the traps were in operation, although they were about a mile distant. Below are given the numbers of weevils which I secured in this way in three days:—

June 28th, ...	96
„ 29th, ...	128
„ 30th, ...	46
Total, . .	270

This method of trapping is a very good one, and it is not attended with much expense. The material for the traps can be obtained at the estate saw-mill, and the cost of conveyance will, as a rule, be small. A man or lad, who knows exactly the location of every trap, should be told off to collect the weevils every morning, and as this can be done by one of the forester's staff, the expense need not be great.

I may also mention that in conjunction with this trapping of the weevils there was carried out, the same season, a rigorous destruction of their larvæ. In searching for these, the stumps of the trees should be well stripped, as the grubs are often found an inch or two below the surface. This operation can be accomplished in the usual routine of the forestry work.

The treatment applied to the two plantations referred to

[1] It has been proved in connection with *Hylobius abietis* that there is no definite limited breeding period, but that the eggs are laid all summer, and that the adult beetles don't die after egg-laying, but hibernate and renew their egg-laying in the next summer.—R. S. M.

certainly saved them from almost complete ruin. As it was, in some places the plants were rather severely damaged, but in consequence of the weevils being so thoroughly dealt with, they recovered rapidly the next season. The plants which suffered most from the attack, taking them in order, were (1) larch, (2) Douglas fir, (3) Scots pine, and (4) spruce. The *Abies nobilis* and silver fir also suffered, but to a lesser extent than any of the foregoing, and even the small patch of Stone pine did not escape. The Corsican pine seemed to be the least favoured of all by the weevil, and the damage done to it was not great.

This method of combating weevil attack, when started in time, and thoroughly carried out, is, I am sure, one of the best that can be adopted. It is certain to lead to good results, and it is simple, inexpensive, and efficient.

12. The Creosoting of Home-Grown Timber.

By W. B. HAVELOCK, Brocklesby Park, Lincolnshire.

The following are the results of tests made in order to ascertain how much creosote oil would be absorbed by various kinds of timber under high pressure. Fifty-six kinds of timber were experimented with, all of which were grown on the estate of the Earl of Yarborough Brocklesby Park, Lincolnshire. The timber was sawn to the sizes stated below, and naturally seasoned in the open air, the creosote being injected under a pressure of 80 to 85 lbs. per square inch (approximately 6 atmospheres) for 3 hours. The creosote (sp. gr. 1040, costing $2\frac{3}{4}$d. to 3d. a gallon delivered to the purchaser's yard) was warmed by steam during use, and a vacuum of 9 lbs. was obtained in the cylinder before it was injected. The last column of figures shows the amount of creosote absorbed per cubic foot of the wood submitted to the process.

Reference No.	Species of Timber.	Number of Pieces.	Size of Pieces.	Weight before Creosoting	Weight after Creosoting	Total Increase in Weight.	Contents of each Piece.	Weight of Creosote Oil absorbed by each Piece.	Weight of Creosote Oil absorbed per Cub. Foot.
			Ft. Ins. Ins.	Lbs.	Lbs.	Lbs.	Cub. Ft.	Lbs.	Lbs.
54	Alder (*Alnus glutinosa*),	2	$6 \times 3\frac{1}{2} \times 3\frac{1}{2}$	$33\frac{1}{4}$	$74\frac{5}{8}$	$41\frac{3}{8}$	·51	20·81	40·80
89	Corsican Pine (*Pinus Laricio*),	6	,,	104	$198\frac{3}{8}$	$94\frac{3}{8}$	·51	15·73	30·84
17	Lime (*Tilia europæa*),	2	,,	$32\frac{1}{4}$	$62\frac{3}{4}$	$30\frac{1}{2}$	·51	15·25	29·90
33	Scots Pine (*Pinus sylvestris*),	2	,,	$33\frac{3}{8}$	$63\frac{1}{2}$	$30\frac{1}{8}$	·51	15·25	29·90
8	Austrian Pine (*Pinus Laricio* var. *austriaca*),	5	,,	$103\frac{1}{4}$	$171\frac{6}{8}$	$68\frac{3}{8}$	·51	13·67	26·80
14	Menzies Spruce (*Picea sitchensis*),	2	$6 \times 3\frac{1}{2} \times 3$	$26\frac{1}{2}$	$48\frac{3}{8}$	$22\frac{1}{8}$	·43	11·06	25·72
10	Heavy-wooded Pine (*Pinus ponderosa*),	2	$6 \times 3\frac{1}{2} \times 3\frac{1}{2}$	30	$52\frac{3}{8}$	$22\frac{3}{8}$	·51	11·31	22·17
22	Beech (*Fagus sylvatica*),	4	,,	106	$150\frac{7}{8}$	$44\frac{7}{8}$	·51	11·21	21·98
75	Hazel (*Corylus Avellana*)	2	$5 \times 3 \times 3$	$27\frac{3}{8}$	41	$13\frac{3}{8}$	·31	6·68	21·54
60	Hornbeam (*Carpinus Betulus*),	2	$6 \times 3\frac{1}{2} \times 3\frac{1}{2}$	$54\frac{1}{4}$	$76\frac{3}{8}$	$21\frac{1}{8}$	·51	10·93	21·43
34	Sycamore (*Acer Pseudoplatanus*),	2	,,	$40\frac{7}{8}$	$62\frac{3}{8}$	$21\frac{3}{4}$	·51	10·87	21·31
12	Walnut (*Juglans regia*),	2	,,	43	$64\frac{3}{4}$	$21\frac{3}{4}$	·51	10·87	21·31
37	Horse Chestnut (*Æsculus Hippocastanum*),	2	,,	$45\frac{1}{4}$	$66\frac{3}{8}$	$21\frac{1}{8}$	·51	10·68	20·94
31	Norway Spruce (*Picea excelsa*)								

21	Birch (*Betula alba*),	1	,,	22⅞	30⅝	7⅛	·51	7·12	13·96
38	Red Elm (*Ulmus campestris*),	4	,,	99⅝	126¾	26⅞	·51	6·71	13·15
104	Oriental Spruce (*Picea orientalis*),	3	,,	41½	61	19½	·51	6·50	12·74
58	Apple (*Pyrus Malus*),	2	4 × 3½ × 3½	36	44¾	8⅛	·34	4·31	12·67
59	Elder (*Sambucus nigra*),	1	6 × 3½ × 3½	25½	31⅞	6⅜	·51	6·37	12·49
61	Weymouth Pine (*Pinus Strobus*),	2	,,	28⅝	41⅛	12¾	·51	6·37	12·49
13	Cedar of Lebanon (*Cedrus Libani*),	2	,,	38⅜	51	12⅝	·51	6·18	12·11
26	Black American Spruce (*Picea nigra*),	2	,,	32½	44½	12	·51	6·00	11·76
106	Japanese Cypress (*Cupressus pisifera*),	1	,,	20	25¾	5¾	·51	5·75	11·27
28	White Thorn (*Crataegus Oxyacantha*),	4	,,	111¼	133⅜	21⅞	·51	5·46	10·70
19	Douglas Fir (*Pseudotsuga Douglasii*),	5	,,	84⅛	110¾	26⅛	·51	5·22	10·23
56	Blackthorn (*Prunus spinosa*),	1	6 × 3 × 3	17¾	21⅜	3⅝	·37	3·62	9·18
47	Japanese Cedar (*Cryptomeria japonica*),	1	6 × 3½ × 3½	21⅜	26⅜	4⅝	·51	4·62	9·06
11	Portugal Laurel (*Prunus lusitanica*),	4	,,	109½	127⅞	18⅜	·51	4·59	9·00
71	Black Poplar (*Populus nigra*),	2	,,	34	43½	9½	·51	4·56	8·94
74	Deodar, or Indian Cedar (*Cedrus Deodara*),	2	,,	34½	43½	9	·51	4·50	8·83
142	Swiss Stone Pine (*Pinus Cembra*),	3	5 × 3½ × 3½	40½	51	10⅞	·42	3·62	8·61
20	Crab (*Pyrus acerba*),	2	6 × 3½ × 3½	59½	68⅜	8⅞	·51	4·43	8·51
39	White Beam (*Pyrus Aria*),	3	,,	54¾	66¾	12½	·51	4·17	8·17
63	Red Oak (*Quercus rubra*),	4	,,	120⅜	135	14⅝	·51	3·59	7·03
5	English Yew (*Taxus baccata*),	2	,,	53⅝	60⅜	6¾	·51	3·37	6·60
73	Huntingdon Willow (*Salix alba*),	4	,,	59¼	72¾	13½	·51	3·37	6·60
15	Gean (*Prunus Avium*),	4	,,	80¾	93½	12¾	·51	3·18	6·23
30	Mountain Ash (*Pyrus Aucuparia*),	2	,,	46⅞	51⅜	4¾	·51	2·37	4·64
48	Turkey Oak (*Quercus Cerris*),	2	,,	65½	70½	4⅝	·51	2·31	4·53
16	Lobb's Arbor-Vitæ (*Thuya gigantea*),	3	,,	57¾	64½	6¾	51	2·25	4·41
18	Evergreen Oak (*Quercus Ilex*),	2	,,	74	78½	4½	·51	2·25	4·41
44	Wych Elm (*Ulmus montana*),	2	,,	47⅝	52	4⅜	·51	2·18	4·27
24	Laburnum (*Laburnum vulgare*),	2	5 × 3 × 3	33	35¼	2¼	·31	1·12	3·61
32	Larch (*Larix europæa*),	2	6 × 3½ × 3½	43⅜	46¼	3⅛	·51	1·56	3·06
69	English Oak (*Quercus pedunculata*),	5	,,	138⅝	145	6⅜	·51	1·27	2·49
4	Acacia (*Robinia Pseudacacia*),	6	,,	162⅞	166⅝	3⅞	·51	0·64	1·25
27	Spanish Chestnut (*Castanea vesca*),	3	,,	88⅜	90¾	1⅞	·51	0·62	1·21

The Creosoting of Fence Posts.

These were Creosoted at the same time as the above pieces of Timber, and under similar conditions.

Reference No.	Kind of Posts.	Number of Posts.	Size of Posts.	Weight before Creosoting	Weight after Creosoting	Total Increase in Weight.	Contents of each Post.	Weight of Creosote Oil absorbed by each Post.	Weight of Creosote Oil absorbed per Cub. Foot.
			Ft. Ins. Ins.	Lbs.	Lbs.	Lbs.	Cub. Ft.	Lbs.	Lbs.
34	Sycamore (*Acer Pseudoplatanus*), . . .	8	6½ × 6 × 5	293½	480	186½	1·35	23·31	17·26
31	Norway Spruce (*Picea excelsa*), . . .	8	,,	294⅜	478½	183⅜	1·35	22·96	17·00
33	Scots Pine (*Pinus sylvestris*), . . .	8	,,	284½	466¼	161⅜	·35	20·21	14·97
40	Silver Fir (*Abies pectinata*), ...	7	,,	234½	339½	105	1·35	15·00	11·11
31	Norway Spruce (*Picea excelsa*), . . .	8	5 × 6 × 4	213½	329⅜	116¼	0·83	14·53	17·50
34	Sycamore (*Acer Pseudoplatanus*), . . .	8	,,	274	386¼	112¼	0·83	14·03	16·90
33	Scots Pine (*Pinus sylvestris*), . . .	8	,,	223	329	106	0·83	13·25	15·96
19	Douglas Fir (*Pseudotsuga Douglasii*), . .	4	,,	101½	120⅛	18⅞	0·83	4·71	5·67
69	Oak (*Quercus pedunculata*), ...	16	,,	665½	731⅛	65⅞	0·83	4·11	4·95
32	Larch (*Larix europæa*), ...	8	,,	235½	258½	23	0·83	2·87	3·45

The timber was all winter-felled. After sawing, it was well seasoned in the open air, in a draughty place and protected from rain, for at least six months—some of it longer. The size of the trees from which it was cut varied very much; but, when trees of that size were available, the samples were taken from stems of not less than 12 ins. diameter. When the trees were sufficiently large, they were first sawn into scantlings, 7 feet long and 4½ ins. by 4½ ins. in cross section. Then, when the pieces had become fairly dry, they were reduced to 6 feet by 3½ ins. by 3½ ins., and were again piled in the open air, in a very draughty place, for about a month longer. That the spruce posts absorbed more creosote than those of Scots pine may perhaps be accounted for by the fact that the latter were sawn out of old, well-hearted park trees, grown in the open, and they therefore absorbed much less oil per cubic foot than they would have done had they been made from younger trees with less heart-wood. Scots pine certainly does, as a rule, absorb more creosote than spruce, and the present results must be regarded as exceptional. No note was made of the proportion of heart-wood to sap-wood in the various specimens; but this is no doubt an important factor influencing the amount of creosote absorbed by each. All the specimens were treated at one time, special precautions having been taken to secure correct identification after creosoting, and to ensure correct weighment both before and after the operation.

[It is hoped that information may hereafter become available in regard to the extent to which each species of timber was penetrated by the oil.—HON. ED.]

13. The Creosoting of Timber by Absorption.

(With Plate.)

By J. BALDEN, Bywell Office, Stocksfield-on-Tyne.

As the members of the Royal Scottish Arboricultural Society who visited Dilston on 2nd August were not able to see the process carried on there for creosoting estate-timber in operation, the following notes may be of interest.

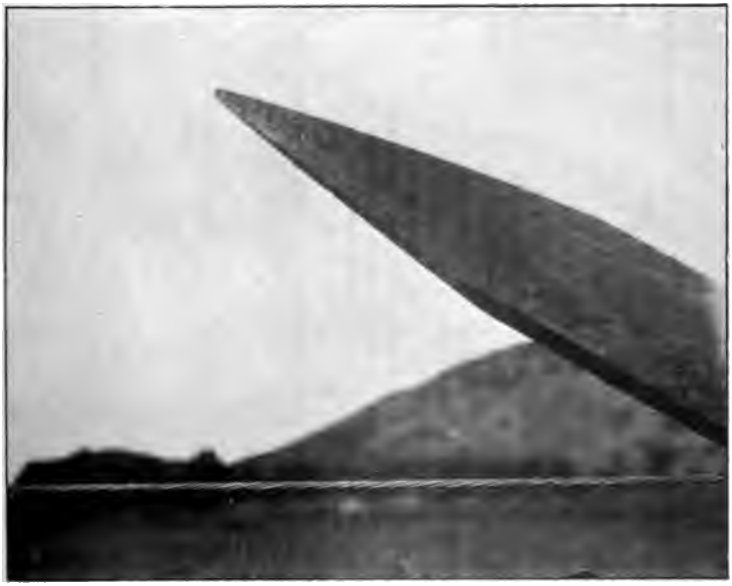
The creosoting-tank measures 16 ft. by 4 ft. by 4 ft. It is made of $\frac{3}{16}$ in. boiler-plates, is fitted with $1\frac{1}{4}$ in. cock for emptying, and has an iron stay across the top at the middle of the tank. Two iron bars, 1 in. square, with the ends turned to clasp the top flange, are fixed across the tank, and when it is filled with timber, wedges are fixed underneath these bars to prevent the timber from floating.

The reader will observe in Photograph No. 1 a simple appliance for the purpose of easily filling the tank with creosote. It consists of a stout larch pole, set 3 feet into the ground, and stayed on cross sleepers. The hoist consists of part of a gate, hung on crooks, and it carries a small check pulley by which the barrels are lifted above the tank for filling it, or, by swinging the hoist round, for removing them as they are filled during the emptying of the tank. The tank is portable. When it is in use the wheels are removed, and it is fixed solid on the ground, the wheels being utilised for the bogie. Corrugated sheets are used to cover the tank when it is full, in order to throw off rain.

The creosote used is of the following specification:—Specific gravity, 10·6 lbs. per gallon; boiling point, 428° Fahr.; entirely liquid at 103°. There is no deposit on cooling to 90°; at 60° there is a deposit of from 25 to 30 per cent. of naphthaline, and it is guaranteed to contain 5 per cent. of tar acids. The price at present is about 3d. per gallon.

This appliance is used for creosoting Scots pine posts and rails, farm building roofing-timbers, sleepers, etc. No heating is required. The drier the wood the more creosote will it absorb. Six weeks' drying in summer is sufficient. When well dried, posts and rails will absorb on an average about $\frac{3}{4}$ gallon per cubic foot.

No. 1.



No. 2.

[*To face page 62.*

The following are recent tests:—

(*a*) 143 cubic ft. of Scots pine scantlings, 12 ft. by 8 ins. by 2 ins., and 12 ft. by 6 ins. by 3 ins. The wood was cut on 16th July; it was put into the tank on 28th August, and remained therein for 138 hours. The amount absorbed was 0·65 gallon per cubic foot.

(*b*) 81 cubic ft. Scots pine sleepers, 8 ft. by 5 ins. by $2\frac{3}{4}$ ins., absorbed 0·61 gallon per cubic foot in 18 days.

These were all cut from trees of about 40 feet on the average.

Mature redwood does not absorb so freely as younger wood. Posts and rails of the former quality are sufficiently creosoted after 48 hours steeping. Photograph No. 2 shows a spruce post treated in this way. It was taken from a post and rail fence in boggy ground, where it had been erected for ten years. The photograph shows how perfect is the preservation. Throughout its whole length the fence was as sound and firm as if newly erected. Scots pine is more readily treated than spruce.

This simple process enables timber to be economically utilised which would otherwise be almost unmarketable. The whole plant costs under £30.

14. Notes on Continental Forestry in 1906.

By JOHN NISBET, D.Œc.

FRANCE.

The *Revue des Eaux et Forêts*, the semi-official fortnightly review of forestry in France, contains a large number of exceedingly interesting articles. It contains, in fact, such a wealth of valuable matter that it is hard to select for condensation into a few pages what may seem of greatest interest, and may perhaps prove most suggestive to the British forester.

Without considering so closely as in 1904 and 1905 the details of the forest budget, it may suffice merely to say that the receipts are estimated at £1,221,200, and the expenditure at £557,200, leaving a net revenue of £664,000, which is just about the same sum as the net income derived by the Government of India from the forests of British India. Of the gross expenditure, £200,380 are allotted to the maintenance and improvement of woodlands and mountain tracts, for the rewooding of which, and the conservation of the soil, no less than £135,000 are set apart. Although a vast amount of attention is given to the forests in France, not only by the Department of Woods and Waters and by Communal authorities, but also by keen politicians and by corporate bodies of different kinds, yet there is a feeling of anxiety about the looming aspect of the timber question and the ensuring of adequate supplies in the future. The note that is struck may well appeal to us too, for if we cannot, as a nation, see our way to provide funds for planting as large a proportion of our waste lands as seems feasible with a fair prospect of profit, then our main chance of being able to provide for our wants in coming days is to have some strong preferential privilege as regards the Canadian timber, about which we must sooner or later enter into a costly economic warfare with our greatest competitors, the United States and Germany.

This is how the internal position in France strikes some of those who are studying it so carefully :—

"In this review it is almost superfluous to repeat that the forestal situation is not satisfactory. No one has forgotten the grave warnings given by M. Mélard in 1900 [as to the world's timber-production decreasing, while the demands for wood are increasing].

"On the one hand, the forests not placed under regular control are disappearing, especially in the mountains, through easy evasion of the ineffectual provisions of the Forest Law as to felling.

"On the other hand, rewooding goes on so slowly that it does not keep pace with the damage that meanwhile increases and extends. It is a work of Sisyphus. 'Since one has been planting, or pretending to plant,' as Thomas Grimm very truly said in the *Petit Journal* of 2nd December 1904, 'all our mountains ought to have resumed their luxuriant covering of former days.' But after 45 years of effort and expense, and of scientific and zealous work, the sum total of our additions is less than 495,000 acres, scattered over the south, centre, and south-east of France." These facts are being discussed and commented on over the whole length and breadth of France, and pressure is being brought to bear on the Government to have the Rewooding Law of April 1882 amended, so that progress may become more rapid. Savants, university professors, civil engineers, and the press condemn its faults. "The south-west, having navigable rivers, has inscribed forestal reform as the foremost of its claims, and in Parliament the discussion of the budget gives rise to warm pleading in favour of forests and replanting. And these are encouraging signs."

"One cannot deny," writes M. Pardé of Beauvais in the preamble to another very interesting article on "The Forestry Question in France," "that forestry is one of the questions of the day in France, as in other countries. It is handled almost daily in reviews and journals by writers of various professions; it is inscribed on the programme of several select committees; numerous societies concern themselves with it; committees are formed in different localities to try and solve it. The problem has two aspects: to preserve and improve the existing woodlands, and to create new woods on waste lands."

A very suggestive side-light was thrown on the question by the considerable increase in the price of all timber, but especially of pitch pine, at the great port of Marseilles last January; and as these high prices have continued right down till now, they can hardly be merely casual and temporary. Being closely connected with the above, special interest is attached to an article on the planting of waste lands in the Department of the Loire, nearly two-thirds of which, or over 1100 square miles, consist of mountainous tracts forming the water-catchment area draining into the river Loire. The valleys, however, are a rich industrial region, silk and cotton being the chief industries; but mines yield over £2,500,000 annually, and these consume nearly 6,000,000 cubic feet of wood (Scots pine) every year, valued at about £160,000, and representing the normal yield of over 120,000 acres. As there are only about 36,000 acres under Scots pine in the Department, it has hitherto drawn its supplementary supplies from the adjoining Department of Haute-Loire; but this latter only contains less than 75,000 acres of pine woods, and has also its own particular demands to comply with. *And this means that hitherto the coal-mines of the Loire districts have only been able to supply their needs by heavier falls of pine-timber having been made than is consistent with rational and conservative treatment of the forests.* So far for the coal-mines alone; but large quantities of light coniferous wood are also required to supply the wants of the 647,000 inhabitants, scattered at over 200 per square mile over the district, and this has to be imported from the Jura mountains and even from Switzerland. In course of time, however, it is greatly to be feared that the rise in the price of timber will become most serious, hence cogent reasons exist for endeavouring to plant as extensively as possible on all tracts not under other forms of cultivation,—while at the same time regulating the falls made in the existing forests, in order to prevent the flooding of the tributary streams and the main river after heavy rainfall.

A small commencement was made in 1862, when £120 were voted for planting and a nursery was formed (now extending to 7½ acres), the plants from which are distributed gratuitously to public and communal bodies and private landowners. In 1904, no fewer than 1,500,000 plants were thus handed over, packed and delivered free of charge at the nearest railway station indicated, a sum of £60 being contributed by the Department for

this and similar purposes. But the demands are growing year by year, and this nursery is no longer large enough to satisfy those now being made, hence two new nurseries are being formed elsewhere. Since 1862, plants or seed have been thus delivered to 1745 different applicants, communes and private parties, and 21,000 acres have been planted at a total cost of £33,120, of which £5520 have been contributed by the Department, £15,280 by private parties, £1840 by communes, and £10,480 by the State. Including everything, the average cost of planting has been £5, 4s. an acre. In 1904 petty subventions, amounting to £1150, have been made by the State and the Department to communes and public bodies towards this work, and the law of 1882 has been applied to ensure the compulsory acquisition and planting of two tracts, aggregating about 10,750 acres.

Throughout the Department of the Loire there are over 100,000 acres of waste land and rough grazing, worth at most only from 1s. to 1s. 4d. per acre per annum. Experiments made on several acres in the commune of Doizien have shown that even by eradicating broom, and dressing with chemical manures parts that are not too rocky or too steep, a seven-fold return of hay can be had over what can be collected on the unimproved land.

To provide useful object-lessons for school children in some of the hill-communes, plots of 12 to 15 acres with good soil, but overgrown by broom and gorse, have been acquired at a cost of about £3, 4s. an acre, and planted by the children. It is expected that at 30 years of age these small plantations will be worth from £32 to £48 an acre, and the profits arising from such plantations will go to augment the contributions to the fund for old-age pensions. The State is assisting this movement by contributing half the sum necessary for buying the land, and defraying the whole cost of planting.

Closely connected with these well-considered and continuous efforts to afforest waste lands, special interest attaches to the results now being obtained from the great work achieved in planting the dunes of Gascony with Maritime Pine. These well-known plantations of the *Landes* were originally begun in 1803 at Lit-et-Mixe, and in 1804 at Mimizan, when the first sowings were made to try and fix the shifting sand. The work of fixation proceeded continuously, being carried out on the largest

scale between 1838 and 1860, and was practically completed in 1864. The planting done from then down to 1880 was mostly in the nature of filling blanks and wooding the *lettes* or lower and more or less inundated tracts.

In the preliminary survey made from 1819 to 1822, the area devastated by the shifting sands in the Landes Department amounted to over 120,000 acres, of which about 87,000 acres required fixation. Of this, about 65,000 acres have been retained in the control of the Forest Department, while the remaining 55,000 acres have been handed over to communes and private owners, or else alienated under laws passed in 1860 and 1863.

In 1906 the woods now vary between 76 and 77 years of age. The oldest woods, 76 and 77 years, only occupy small areas in the forests of St Julien-en-Born and St Eulalie; and usually the oldest class does not exceed 60 to 65 years of age—the age being uniform over large tracts operated on simultaneously, as, for example, in the forest of St Eulalie, where there are 6700 acres dating from 1862. This uniformity of age must, of course, give rise to practical difficulty as regards the first regeneration of these woods; and their ages usually decrease from east to west, which also complicates matters for the first regeneration.

A working-plan was drawn up for these forests during 1884 to 1887. The communal tracts were taken as the units on which operations were based, and the blocks of forest have been treated separately or grouped together according to their extent, while the forests themselves bear the names of the communes in which they are situated. There are 11 such forests in all, which form 2 Inspectorships (Mont-de-Marsan and Dax) in the Bordeaux Conservatorship. These forests are treated as highwoods, by means of gradual clearance and natural regeneration. The rotation is fixed at 75 to 80 years, divided into 15 or 16 periods of 5 years each (corresponding to the area of 5 compartments, and equal to 5 annual falls), while the estimated yield is fixed by the cubic contents to be expected. According to their extent, the different forests are divided into from 2 to 6 working-circles, which extend in long strips parallel to the sea-coast, and are marked off by the parallel paths or fire-traces. The first falls are, of course, allocated at the eastern edge of the whole block. In each working-circle the annual falls are numbered, and the

normal course of regeneration is fixed from north to south. In each forest *excluded woods* have been omitted from definite treatment along the dune and the coast-zone, in order to form a wind-screen protecting the main block of woods to windward from the action of storms and of sand thrown up by the sea.

The prescriptions of the working-plan are very simple. Throughout each quinquennial period, each compartment, except that to be regenerated and those forming young woods, is given a thinning accompanied with tapping of resin, while the trees to be removed are tapped to death for 4 years before their fall, and simultaneously the stems girthing over 4 feet are lightly tapped for 5 years. The oldest compartment, or that coming in its regular turn, is regenerated by clear-felling preceded by exhaustive tapping of all the trees, these being cut in the fifth and last year of the period. The compartments forming young woods are run through by ordinary thinnings, without being tapped.

Every fifth year, at the commencement of each period, each working-circle is gone through, and distinctive State hammer-marks are put on all stems which are to be either sold standing for clear-felling, or thinned out, tapped to death, and sold standing, or else merely lightly tapped. This involves a large amount of careful selection. In 1905, in the Mont-de-Marsan Inspection, the hammer-marking extended to 5 working-circles, having an area of over 15,000 acres; it lasted over $4\frac{1}{2}$ months, and 612,455 stems were marked (456,795 for tapping to death, and 155,660 for light tapping).

The first clear-fellings for regeneration began at Mont-de-Marsan in 1901, in the forest of St Eulalie. Until then only thinnings and tapping had taken place; and the mature falls began just when a considerable rise was occurring in the price of timber and resin. But already instructive details are available as to the yield in material and money. In the clear-falls the final outturn consists of about the following percentages: timber 60, pit-wood 20, fire-wood 20. In the thinnings the relative proportions vary, of course, according to the age, but in woods of 35 to 50 years old it works out to timber 35, pit-wood 45, fire-wood 20. The amount of resin obtained varies, but is approximately about $\frac{1}{15}$ of the tonnage of the wood. In the woods that are being thinned, 50 of the vigorous stems tapped

lightly yield a *hectolitre* of resin (22 gallons, or 2¾ bushels), whereas it takes 59 of the stems that are being tapped to death to produce the same quantity. In falls for regeneration in the woods of 65 to 70 years old there are left on the average about 80 trees an acre, and in the 4 years of exhaustive tapping they yield about 19 hectolitres (418 gallons, or 52¼ bushels), *i.e.*, 17 trees are required to furnish 1 hectolitre of resin.

Space forbids the citation of details as to the extent and age of recent falls, the amount of material extracted, and the prices obtained, etc., which can have no great practical value for the British forester. What is noteworthy, however, is that down to 1894 these plantations had always, from year to year, cost more than they brought in; but in 1895 there was the first small surplus of £134, and this has been steadily increasing till it reached nearly £20,000 in 1905; and in future years, as a much larger proportion of the woods become mature, the net revenue will increase proportionately. Although the first final falls in the Mont-de-Marsan Inspection, begun in 1901, had to take place in woods ranging from 23 to 63 years at the commencement of each period, yet the annual gross income from these 56,000 acres amounted to £61,600, and must increase largely from year to year—and all the more because the local value of both the wood and the resin have been steadily rising during the last 7 or 8 years, timber having increased by 50 per cent. since 1898, and oil of turpentine by 175 per cent. since 1895.

Formerly one of the most desolate and sterile districts in France, these coast tracts, covered with Maritime Pine, are now, thanks to the work initiated 120 years ago by Brémontier, traversed by roads and railways, and dotted over with saw-mills furnished with all the latest machinery and appliances for converting logs into planks, parquet-boarding, panelling, etc., and have uplifted the whole region into a highly prosperous condition, with profitable industries firmly fixed on solid foundations.

It seems to convey a lesson to Britain, if Britain is minded to consider the whole matter attentively. We have our coal-mines, which alone in the future will require more pit-wood than we are ever likely to grow within the United Kingdom; and unless we form extensive plantations soon, the price of pit-wood may, in the course of the next 20 to 40 years, rise so high as greatly to increase the cost of coal. But the pith of the lesson seems to me to be that any great national scheme of planting in England,

Scotland, Ireland, or Wales should, to have a proper chance of success, be dealt with in a scientific manner likely to combine efficiency and economy, and not be rather jumped at hastily and without careful elaboration of a far-seeing scheme. It has only been by adopting careful scientific methods, and employing well-trained agents, that the above successful results have been obtained on the south-west coast of France.

The Colonial Forest Departments in Algiers, Tunis, and Indo-China all show a net surplus for 1905, and the Algerian Service has been placed on a more favourable footing by a recent increase in pay. The question of colonial forestry is apparently not neglected by the central Government even in the smaller colonies, because the Ministry of the Colonies has recently sent a "forest mission" to inquire into and report on the best measures that can be taken to protect the existing woodlands, and to study the question of planting in the Upper Niger, Upper Senegal, the Tchad, and other regions. These inquiries are expected to have important results on the climatic conditions and the regulation of the water-supply in the rivers throughout the territories to be visited.

As in previous years, the results are published of investigations made into the diseases of fresh-water fishes, the inland waters being under the control of the Forest Department. The interests thus concerned are very important; and there can be little doubt that if any great national scheme of planting be adopted in the United Kingdom, the subject of inland fisheries will raise up many problems much more difficult to solve than those that have now there to be dealt with.

The past year has added one new insect to the large number of those already classifiable as injurious. In the late summer of 1904, about 15 acres of Scots pine near Embrun, in the Hautes-Alpes, were found to be infested in the foliage by a small moth, which was thought to be *Leucaspis pini*. But Dr Leonardi, the Italian entomologist, has ascertained that this is a new, though very closely allied species, and has named it *Leucaspis affinis*. Apparently, however, its attack has not spread, as no mention has yet been made of this during 1906.

Among fungous diseases, *Trichosphæria parasitica* has been doing a good deal of damage in some of the silver-fir woods on the Hautes Vosges. It appears to secure rather an easy foothold in that damp climate, and especially on hill-sides with a

northern aspect; and it is most apt to make its appearance in woods that have been allowed to grow up too thick, on account of thinnings being delayed.

Last year produced a rich mast in the beech-woods at St Gobain, in the Aisne, and attracted such swarms of wood-pigeons that a rough estimate was made of the loss they were causing. It was calculated that there were fully 10,000 pigeons. As the crops of some shot at 9 o'clock in the morning held from 54 to 79 beech-nuts, it was estimated that each pigeon would consume about 150 daily, amounting to 1,500,000 for the whole of the flocks. As the pigeons remained feeding there for a full month, this meant the destruction of 825 bushels of beech-nuts, worth £300, and sufficient for the broadcast-sowing of 125 acres. The actual result of this visitation was that all the good seed was completely consumed throughout the mature falls prepared for natural regeneration. The question may well be asked, "Why was this destruction allowed to go on unchecked for a whole month?" Although the wood pigeon is known to be injurious, yet it appears that the subordinate forest officials have no general authority to shoot it. In any case, it is difficult to reduce their numbers largely by shooting; but organised effort to harass them continually would keep them on the move, as they do not like being disturbed. If scared away from the woods, however, this would only mean that they were being driven to prey on the farmer—for, like the destructive rabbit, they must satisfy their voracity somehow, whether in the woodlands or in the fields.

Amendments to the *Code Forestier* have recently been laid before Parliament. One of these, dealing with fines for damage done by farm-stock grazing in woods, serves to show what is officially considered the sliding-scale in this respect, viz., for a pig 1, a sheep 2, a horse or mule 3, a goat 4, and an ox, cow or calf 5 francs; and the amount of the fine is the double of that if the woods trespassed in are less than 10 years old.

The public parks and gardens within the city walls of Paris—and therefore exclusive of the Bois de Bologne and Bois de Vincennes—aggregate 530 acres, of which 310 acres belong to the town. In these public ornamental grounds there have been planted over 38,000 trees and 417,000 shrubs, while other 86,700 trees have been planted along the boulevards, streets, etc. These 125,000 trees would form quite a large woodland if growing all

in one mass, and it would then be a remarkable mixture of all kinds of indigenous and exotic trees of an ornamental character. In the streets of Paris wood-paving continues to increase rapidly, and in 1904 over 20 per cent. of the total roadway had been paved with wood-blocks. Along with other merchandise, wood brought into Paris is subject to payment of *octroi* duties, which have been raised considerably for wrought wood during the past year. For rough unfashioned hardwoods the duty is 11·20 francs per stère, or about 3d. a cubic foot, while for wrought and fashioned wood it is 13·30 francs, or over 3½d. a cubic foot. Softwoods are somewhat less heavily taxed; but these imports must increase the cost of building very considerably. In Britain we escape such imposts, although this only means that the taxes levied by our municipalities are based on other foundations and collected in a different manner.

GERMANY.

The German forestry journals contain, as usual, a wealth of scientific information. But, also as usual, there are a great many papers of a more or less purely mathematical nature. For more than thirty years there has been constant wrangling about increment, valuation of soil and crop, etc., all involving very learned-looking algebraic formulæ. Viewed from a practical, common-sense point, there is far too much of this *pseudo-scientific* hair-splitting in the German forestry journals, involving bitter argumentation as to the application of the financial theory to the problems of sylviculture. In practice the financial theory is adopted by every State in its forest conservancy. The main objects of the prescriptions laid down for management are—(1) conservation, and (2) the realisation of the largest net income obtainable consistent with due conservation, and the attainment of the various national-economic objects included under this comprehensive term. This seems completely lost sight of when the highly-trained German foresters take pen in hand to indulge in pseudo-scientific paper warfare, and to wrangle about comparative trifles. Hence many of the learned articles are of little or no practical value to the forester, and especially to the British forester; and consequently that which may interest and aid him most has to be looked for chiefly in the discussions raised at local meetings, and in reports made about results attained in different portions of the German empire.

The statistics of the Prussian forests published in 1906 show that they are constituted as follows:—

HECTARES (=2·47 acres).		
State Forests,	2,630,890[1]	8,270,134
Communal Forests,	1,438,047	
Private Forests,	4,201,197	
Broad-leaved Trees,	2,554,636	8,270,134
Coniferous Trees,	5,715,498	
Copses and Coppices,	869,489	8,270,134
Woods treated by "Selection,"	955,061	
Highwoods (including blanks and clearances),	6,445,584	

[1] The official statistics for 1904 give a total area of 2,847,930 hectares, of which 2,554,259 are wooded and 293,671 not wooded.

How far the gradual endeavours to establish a normal series of age-classes has hitherto been successful may be judged of from the following summary:—

	Over 100 Years.	81–100.	61–80.	41–60.	21–40.	Up to 20.	Blanks.	Clearances.
Broad-leaved Highwoods [1]—								
State Forests,	124,217	92,192	103,481	100,946	83,234	78,106	7,596	2,341
Communal ,,	55,934	71,603	88,946	83,223	69,844	54,291	2,155	1,540
Private ,,	50,274	46,839	64,745	79,720	91,073	77,597	4,537	3,916
Conifer Highwoods [1]—								
State Forests,	261,455	218,210	271,828	387,613	381,256	387,215	19,177	38,145
Communal ,,	13,611	35,621	66,517	129,690	178,383	175,342	10,181	15,471
Private ,,	60,716	121,950	255,312	488,858	672,153	701,407	54,483	62,642

[1] In hectares (=2·47 acres).

In both of the above classes of highwoods the tendency of private owners to work with a lower rotation than the State seems clearly traceable—and very naturally so, as that means locking up less capital in the growing-stock of timber, also

getting earlier returns, and, on the whole, a larger percentage from the total capital invested in land and timber-crops.

The 7,000,000 acres (in round numbers) of Prussian State forests yielded in 1904 over 412,000,000 cubic feet of wood, or about 65 cubic feet per acre actually stocked, and of this total rather more than the half was used for timber, while rather under one-half had to be disposed of as fuel. The total income realised was over £5,854,400, and the expenditure incurred amounted to £2,755,230, leaving a net surplus of £3,099,107, which shows a clear income of 9s. 7d. per acre actually culturable. Cultural operations extended to nearly 32,000 acres, and cost £43,500. Employment was given to 156,772 hands for a total of 10,479,589 days.

But in some respects the details regarding sport within these Prussian State forests are for us perhaps the most interesting of all. I have often pointed out that forestry and sport are not inimical—bar rabbits, which are really only glorified vermin, destructive to both field and woodland crops—and the official statistics throw an instructive light on this. Shooting brought in an income of £23,550, of which £7400 were for shootings let outright, and £16,150 for those "administered" by the State —that is to say, an estimate is made of the existing head of game, and of the number of each kind that shall be shot during the year, and the right of shooting to that extent is let generally to the head forester in charge of the forests at a very moderate amount, perhaps less than the food-value of the game. The total bag for these "administered" shootings alone was in 1904:— 4 elks, 2176 stags, 3276 hinds, 1726 calves; 1673 fallow-deer and 1128 calves; 9969 roebucks, 5264 does, 400 calves; 2246 wild boar, 107 capercailzie, 162 black grouse, 405 pheasants, 7 wild swans, 2865 hares, 910 partridges, and 69 moorfowl. *Not a rabbit!* but there they are treated as vermin. These returns of feathered and ground game seem poor; but such "lower hunting" is generally let outright to the forest officials, and no returns are in that case called for. It is unnecessary to expatiate on the quality of sport which is represented by 2176 stags and 2246 wild boar, and especially the latter, because a wounded boar is a nasty customer to contend with, a regular "thrawn deevil."

Throughout all these 7,000,000 acres of woods, many of them highly inflammable pine-tracts, only fifteen fires occurred in

1904, in which 2300 acres were seriously injured, and 1500 acres only inappreciably or slightly damaged. This seems to indicate not only excellent protective measures, but also a very striking absence of ill-feeling between forest officials and the rural population.

As is well known, Prussia, like Saxony, prefers to maintain two forest academies (at Neustadt-Eberswalde near Berlin, and Muenden near Cassel) in place of instituting theoretical instruction at one or more of its universities. These academies require no extraneous assistance in their teaching; each is fully equipped in this respect, and it may be useful to summarise briefly their teaching strength, frequentation, and cost:—

Winter Session 1904 to 1905.	Eberswalde.	Muenden.
(*a*) Teachers of Forestry—		
Director,	1	1
Ordinary Professors,	4	3
Assistants and Tutors,	5	5
(*b*) Teachers of Natural Science, Mathematics, Land Surveying, and Road-making,	6	5
(*c*) Teachers of Law and National Economy,	1	
Total,	17	15
(*a*) Students for State Forest Service—		
In Prussia,	18	37
In other German States,	...	2
(*b*) Students for other than State Service—		
In Prussia,	16	13
In other German States,	9	8
Foreigners,	23	8
Total,	66	68
Income,	£596	£469
Expenditure,	£6773	£4661
Net Cost of Instruction,	£6177	£4192

These teachers are all men of high scientific attainments, some of whom have a European and even a world-wide reputation; and however much anyone may perhaps desire to see a similar academy of forestry opened in any part of the United

Kingdom, yet one must at once admit that it would be quite impossible to provide such a high class of theoretical instruction for such a moderate annual expenditure.

In one very important respect as to its future development Prussia occupies a much more favourable position than Britain—namely, in regard to adequate, well-ensured supplies of pit-wood for the coal-mining industry. It now furnishes about 175,000,000 cubic feet of pit-wood annually, which represents about one-fourth of its total production of wood. This is attained in the ordinary course of prudent management, and without any purpose of growing woods with a low rotation and solely for pit-wood, which it is considered unwise to attempt owing to the fact that every now and again the market for small stuff of pit-wood size is liable to be strongly influenced by calamities such as heavy windfall or extensive injuries by insects, etc.

Among the most important of the recent publications on German forestry is Professor Endres' (of Munich) *Handbook of Forest Policy, Legislation and Statistics*. This is the most complete and up-to-date work on this branch of sylvicultural knowledge. Among some of the innumerable matters with which he deals, one is naturally anxious to know the latest conclusions that have been drawn from the experiments still going on to ascertain the effects of forests on atmospheric precipitations. The conclusions here shown are that the woodlands do not increase the rainfall, but merely influence its distribution within the wooded area and its immediate vicinity. As regards the hydro-economic effect of woodlands in increasing, retaining, and consuming the water that finds its way into the soil, it can meanwhile only be said that on level ground the woodland soil is moister than soil in the open merely to a depth of about 6 inches, whereas in the lower layers, which are those generally pervaded by the root-system of trees, it is considerably drier than soil in the open. But in hill-forests the hydro-economic conditions are more favourable in the woodlands; *hence wooded mountain tracts may justly be considered the chief water-reservoirs throughout Continental Europe*, as was proved by Ebermayer and Hartmann's investigations, published in 1904. What applies on the Continent will also apply in Britain, and the large plantations now being made in water-catchment areas in connection with the water-supply of Edinburgh, Liverpool, and other cities will in due time produce most beneficial results.

Another important publication recently is the third edition of Professor Sorauer's *Handbook of Plant-Diseases.* Of special interest in this regard is what he has to say about the predisposition of the larch to infection by the canker-fungus. Basing his remarks on Weber's researches into the influence of soil and situation on the chemical composition of the ash of larch timber, he points out that the transference of the larch from its indigenous mountains to the plains has, in many cases, occasioned a change in the manner of growth, whereby its immunity against diseases has been destroyed. In the comparatively mild and damp autumns on the plains the close of the vegetative period is delayed, and therewith the entrance into the period of winter rest that is necessary for its normal development—much in the same way, to give a homely example, as late hours are bad for young children. One frequent result of this is that it becomes less hardy against frost; and with the formation of any sort of wound caused by frost the door is, of course, opened for the entrance of wound-parasitic fungi. Hence Sorauer urges the importance of in future considering, more than has hitherto been done, the suitability of soil and situation for any particular kind of tree brought from mountain tracts into low-lying localities, and to *avoid the mistake of being misled by the belief that each kind of tree can thrive wherever plenty of food-material is available for it.* And, of course, this just comes to the practical common-sense opinion, based on everyday observation and experience, that not only the larch, but also every other kind of tree, will thrive most vigorously and be least liable to disease of any sort when it is grown on a soil and situation suited to its normal requirements—and also that the more the soil and situation vary from such normal standard for any tree, the less will be its power of withstanding climatic influences, diseases of all sorts, or the attacks of noxious insects.

A scheme for carrying out manuring experiments in connection with the German Forest Experimental Establishments has been drawn up, so that in the near future interesting results are likely to be ascertained and published. This question is now undergoing careful investigation at various centres, and is certain to be well threshed out. Exhausted nurseries, of course, need rehabilitation, and nurseries on poor soil require to be improved and brought up to proper fertility; but the methods hitherto adopted are now going to be examined very critically. Professor

Wein (Munich) is of opinion that as artificial manuring pays in agriculture, it should be even more profitable in forestry. The requirements as to plant-food for woodland trees is not small, as, for example, in the case of 1- and 2-year old Scots pine, which extract from the soil about 60 lbs. of nitrogen, 40 of potash, 25 of phosphoric acid, and 50 of lime per acre. Hence, he considers, the gradual but certain exhaustion of woodland soil should be counteracted by suitable manuring. Woodland soil, he says, is deficient especially in a regular source of nitrogen, such as is supplied to farm-land by stable-manure and the accompanying activity of soil-bacteria, with the result that good farm-land contains up to 0·15 per cent. or more of nitrogen, as compared with only 0·01 to 0·03 per cent. in woodlands. And the same is the case, he states, as to phosphoric acid, although there is generally sufficient potash, except in very light soil and moorland. He shares the opinion held by some (see our *Transactions*, Vol. XIX. Part II., 1906, page 249) that quickly-grown plants, raised in rich nurseries, are better able to thrive when transplanted to poor woodland soil than plants of less rapid development; but exact investigations will in due course of time prove whether there may not be here, as in so many other things, a golden mean. Certainly, if animal life may be allowed to furnish any fair and reasonable analogy, a human being of any age—child, youth, or adult—is better able to satisfy any demands made on him or her if merely well nourished, and neither too richly fed nor in any way starved. The opinion may be wrong, but if I were purchasing plants I should personally prefer well-developed, well-rooted, compact, healthy-looking, sturdy, bushy plants, grown on a good soil somewhat above the medium. Put such in a better soil than that of their nursery, and they will very soon overcome the disturbance caused by transplanting; and if they are unfortunately to be put out on land much poorer than the nursery, there is, one would think, more chance of the plant soon accommodating itself to the changed environment, and the more or less damaged condition of its root-system, than if it had been accustomed to considerably larger food-supplies in the nursery. This touches, however, on a physiological question that has perhaps not yet been fully studied—namely, Can any plant imbibe more food than is sufficient for its natural requirements, or than can be assimilated in a thorough manner, or stored up with advantage to the indi-

vidual organism? If not, then plants are much better endowed in this respect than animals, as all of us must know from personal experience. One knows, however, from observation and experience, that plants of rank growth are more liable to suffer from early autumn frosts than those which close their vegetative period fairly early in the season.

Another point which should, I think, be noted, is that young plantations of extremely rapid growth at first do not necessarily thrive later on. I know a case in Hampshire where the growth of a larch plantation was extremely rapid for 8 or 9 years, then suddenly the whole plantation became attacked with canker and had to be entirely cleared. The same occasionally occurs with Scots pine on land that has been under farm-crops. A very interesting article in the *Zeitschrift für Forst- und Jägdwesen* for March 1906, describes how a young Scots pine-wood which had grown remarkably quickly on farm-land suddenly became infested with *Fomes annosus* and then with *Agaricus melleus* at about 20 years of age. As the subsoil was similar to that in the surrounding woods that were not thus affected, there is a strong probability that the sudden loss of constitutional vigour was due to something connected with the surface-soil and its former manuring, although these had undoubtedly been the cause of the rapid growth during the early years of the plantation.

A Forestry Exhibition has been held during this year at Nuremberg, concerning the many interesting exhibits in which some remarks may perhaps be made elsewhere.

15. The Twenty-ninth Annual Excursion—Northumberland and Durham, 31st July to 3rd August 1906.

By the ASSISTANT EDITOR.

The Twenty-ninth Annual Excursion of the Society was held in the counties of Northumberland and Durham, the estates visited being Alnwick, Lambton, Dilston, Healey, Minster Acres, and Cragside. The Excursion party, which was under the leadership of Mr Buchanan, the *Convener* of the Excursion Committee, assembled at the Central Station Hotel, Newcastle-on-Tyne, their headquarters during their visit to the district, on the evening of Monday, 30th July. The party consisted of the following gentlemen :—W. Steuart Fothringham, Esq. of Murthly, *President*; J. W. A. Adams, Mill Hill, Middlesex; Robert Allan, Polkemmet, Whitburn; Thomas Bond, Lambton; Dr A. W. Borthwick, *Hon. Consulting Cryptogamist*, Edinburgh; J. B. Braid, Whitley Court, Stourport; Charles Buchanan, Penicuik; Thomas Christie, Forres; James Cook, Arniston; R. W. Cowper, Gortanore, Sittingbourne; T. Alex. Crombie, Longhirst, Morpeth; Wm. Dick, Hamilton; Alex. Finlayson, Hardengreen, Dalkeith; A. C. Forbes, Armstrong College, Newcastle; James Forbes, Overtoun, Dumbarton; Robert Forbes, Kennet, Alloa; Alex. Fraser, Inverness; Robert A. Fraser, Edinburgh; Robert Galloway, *Secretary*, Edinburgh; Sydney J. Gammell of Countesswells; A. T. Gillanders, Park Cottage, Alnwick: George Halliday, Rothesay; J. Smith Hill, Aspatria; James Kay, Bute; Thomas Kennedy, Lambton; A. M'Gregor, Penicuik; W. M'Kerchar, London; D. L. Mackintosh, Stronvar, Balquhidder; W. J. H. Maxwell of Munches; John Methven, Edinburgh; Alex. Milne, Edinburgh; Wm. Milne, Foulden, Berwick-on-Tweed; Wm. Milne, Hexham; A. B. Motherwell, Airdrie; A. J. Munro, Edinburgh; George A. Munro, Edinburgh; E. B. Nicholson, Edinburgh; James Pearson, Sessay, Yorks; Geo. Porteous, Lasswade; W. Ralph, Corstorphine; A. D. Richardson, *Assistant Editor*, Portobello; J. Robb, Edinburgh; H. Rutherford, Fairnington, Roxburgh; Thos. Sharpe, Monreith, Wigtownshire; James Shiel, Abbey St Bathans, Grant's House; Wm. Steven, Dalkeith; Duncan D. Stewart, Castlehill, Inchture; Jas. Stoddart, Bonnyrigg;

Walter C. Stunt, Lorenden, Kent; Jas. Tait, Penicuik; Jas. Wm. Watt, Carlisle; E. Whittinghame, Newport, Salop; Jas. Whytock, Dalkeith; Edward Wiseman, Elgin; Ralph J. Wylam, Lambton.

On Tuesday morning a start was made for Alnwick Castle, the seat of the Duke of Northumberland, but owing to an unfortunate breakdown in the weather a considerable part of the day's programme which had been mapped out by Mr Gillanders, the head forester on the estates, who acted as guide to the party, had to be abandoned.

The party arrived at Alnwick at 11 o'clock, and scarcely had the day's proceedings commenced when a violent thunderstorm, accompanied by torrential rain, broke, and continued with more or less severity till mid-afternoon. Before they had to seek shelter, however, Mr Gillanders was able to show the Excursionists a small experiment which he had commenced in order to ascertain how plantations of ordinary broad-leaved trees formed on grass land and bare ground respectively would be affected by (*a*) allowing the herbage in the former case to have free scope, and (*b*) by keeping the latter continuously under hoe and rake. One of the well-equipped estate nurseries was next visited, but by this time the rain had commenced to descend in torrents, and shelter had to be sought. Taking advantage of lulls in the storm, the party made their way on foot by way of the Castle and the beautiful gardens to the White Swan Hotel, where they were kindly entertained to luncheon by the Duke of Northumberland. Mr Fothringham proposed a vote of thanks to his Grace for his hospitality, and for allowing the party to visit his property, and to Mr Gillanders for his trouble in arranging the Excursion. Thereafter a visit was paid to one of the estate saw-mills. Here much of interest was seen. Besides ordinary wood-working machinery and creosoting plant, one or two novel features in estate work were observed. One of these was the conversion into wire fencing material of old steel pit winding-ropes. These old ropes are purchased at about £2, 10s. per ton, and, by special appliances, they are unwound and the strands composing them, after being dipped in hot coal-tar, are used as ordinary fencing wire. Another novelty seen here was the Hoe "chisel-tooth" circular saw, an American invention, in which the teeth are detachable from the disc; but its work did not produce a very

favourable impression among the timber merchants present, its cross-cutting being more of the nature of a tear than a cut. Tea was served at Hulne Abbey, and on the way through the policies to Alnwick station some fine old silver fir, a few large Douglas fir, and a number of good clean-grown larch, girthing 8 feet at breast-height, were observed.

On Wednesday, 1st August, the Excursionists visited Lambton Park, the seat of the Earl of Durham. Driving from Newcastle, Lambton was reached at 10 o'clock, and on their arrival the party were met by Mr Bond and Mr Smith, the forester and gardener respectively at Lambton, who acted as chaperons. In marked contrast to that of the previous day, the weather was delightful, and the park, which is a very extensive and finely wooded one, and gardens were seen at their best.

On entering the policies, the party made a tour of the grounds in the vicinity of the Castle, which occupies a commanding position overlooking the valley of the Wear, and after an inspection of the beautiful garden and some other parts of the grounds, they drove to Bowes House Farm, where lunch was served. Mr Fothringham proposed a vote of thanks to Lord Durham for his kindness in allowing the Excursion party to visit his estate, and to Mr Bond for the pains he had taken in connection with the arrangements for the visit, and thereafter a visit was paid to one of the estate saw-mills and timber-yards. Here a good deal of discussion took place regarding the lasting properties of some of the timber which was being converted into fencing material, and Mr Bond mentioned that well-seasoned oak posts had been found to be quite sound after being twenty years in the ground. The party returned to Newcastle early in the afternoon in order to take part in a conference at the Armstrong College, and to hear a paper read there by Mr A. C. Forbes on "The Value of Waste Land for Afforestation Purposes."[1]

On arrival at the College the party were kindly entertained to tea by Lord Barnard, D.C.L., the Chairman of the Agricultural Committee. Lord Barnard was unable to be present, and Professor Lebour, the Vice-Principal, who was introduced by Professor Gilchrist, welcomed the party to the College. Mr Fothringham, on behalf of the Society, thanked Lord

[1] It is hoped that the paper may appear in the July part of the *Transactions*.

Barnard and the College authorities for their kind reception, and Professor Gilchrist returned thanks on behalf of Lord Barnard and his colleagues. In doing so Professor Gilchrist mentioned that, as the result of an agreement entered into between H.M. Office of Woods and the College authorities, the local management of the Chopwell Woods had been taken over by the College, and that these would afford opportunities for practical demonstration to the College students of forestry.

Before the reading of Mr Forbes's paper the party were conducted over the electrical and engineering laboratories, in which some interesting experiments were shown. In the engineering laboratory a fine testing-machine has been installed, and a demonstration in timber-testing, the chief result of which was to show that clean-grown foreign coniferous timber is much stronger under a crushing strain than that of home growth, was given for the benefit of the party.

The Annual Excursion Dinner was held in the Central Station Hotel in the evening, the President, Mr Steuart Fothringham, being in the chair. The loyal toasts were given from the chair, and other toasts proposed were the Lord Mayor, Magistrates and Town Council of Newcastle, by Mr Gillanders; the Guests, by Mr Buchanan; the Royal Scottish Aboricultural Society, by Sir Francis Walker, Commissioner to the Duke of Northumberland; Kindred Societies, Educational Institutions, and the Landed Interest.

Thursday, 2nd August, the Excursion party spent in the neighbourhood of Hexham. From Newcastle to Hexham the journey was by rail, and on their arrival at Hexham they drove to Dilston, the property of Mr Beaumont, M.P., where they were met by Mr Balden, the estate agent, who acted as guide. In passing through the "Devil's Water Glen," some fine clean-grown oak and larch, girthing about 8 feet on the average at breast-height, were seen, and after an inspection of a thriving young larch and Scots pine plantation on the Duke of Northumberland's property, the Dipton Woods, part of which belong to Mr Beaumont and part to the Duke of Northumberland, were entered. On entering the first section of these, which belongs to the Duke of Northumberland, Mr Gillanders, his Grace's forester, produced and explained a working-plan which he had prepared for the systematic management of all the woods on the ducal property here. In a part of the Dipton

Woods belonging to Mr Beaumont a crop of Scots pine one hundred years old received a good deal of attention from the party. The crop was very good, but, owing to its having been thinned rather freely in the early stages, the timber was somewhat rougher than it should have been. The plantation contains something like 9000 cubic feet per acre, which, at 4d. per foot, works out at £150 per acre. A younger part of the same wood, belonging to the Duke of Northumberland, was also visited, and after an inspection of the portable saw-mill which was being used here, and a demonstration of the method of extracting the timber from the adjoining woods, by means of a winding-drum and wire cable with which the traction engine which drives the saw-mill is provided, the party repaired to some thirty-year-old plantations, also on the Duke's property, where Mr A. C. Forbes has commenced some interesting experiments to show the effects respectively of (*a*) removing from the ground, every third or fourth year, the needles shed by the trees, (*b*) leaving the needles as they fall, and (*c*) dressing the ground with beech leaves.

After lunch at Holly Bush, an inspection of some newly formed Scots pine plantations on the Duke of Northumberland's property was made. The soil is of a light sandy nature, with an overlying layer of thin peat, carrying a strong crop of heather. In planting this, Mr Gillanders has adopted the plan of removing wholly a large turf, about a yard in diameter, where each plant is inserted, in order to get the roots into the mineral soil beneath, and the results seemed to amply justify the method employed. Some young Scots pine plantations on the same property, on which experiments with various kinds of artificial manures were being carried out, were next visited, and the party thereafter repaired to a part of the Dipton Woods belonging to Mr Beaumont, where some splendid larch were seen. These trees are ninety years old, and a sample acre contains 6600 cubic feet, which, at 1s. per cubic foot, works out at £350 per acre, and this on ground which, it was stated, is not worth more than 1s. per acre for other purposes. A hurried inspection of a rather open thirty-year-old Scots pine plantation, some parts of which had been badly damaged by squirrels, on the Healey estate was made *en route* to Minster Acres; and at the latter place, where a short halt was made, some fine specimen conifers were seen, including an avenue of Wellingtonias of very vigorous growth.

The party then drove to Riding Mill, whence they returned to Newcastle by train.

The Excursion was brought to a close by a visit to Cragside, the residence of Lord Armstrong, on Friday, 3rd August. This property was acquired by the late Lord Armstrong, and by bringing to bear on the problem the happy combination of engineering skill and fine taste for landscape effect which he possessed, what at the time he entered into possession was a sheer waste has been converted into a beautiful demesne, teeming with ornamental coniferous and broad-leaved trees and flowering shrubs of every description. The soil is in many parts of the property very shallow, so shallow, indeed, that it is insufficient to conceal the underlying rock, and in the vicinity of the mansion-house enormous quantities of soil had to be transported for the establishment of the plants. But so skilfully has everything been carried out, that it is now difficult to imagine the ground ever having been the waste it formerly was.

The party travelled from Newcastle by rail to Rothbury, and on their arrival they were met by Mr Bertram, the overseer on the estate, under whose guidance they were conducted over the demesne. On the out-lying parts the principal coniferous trees used are the Scots and mountain pines, trees well adapted to thin poor soil such as this is. An inspection was made of the splendidly equipped laundry, the workshops, the electric power house, and other objects of interest, and thereafter the party drove through the grounds, by another route from that by which they entered, to Rothbury, where lunch was served in the Station Hotel. After lunch, a start was made for Brinkburn Station. On the way, a halt was made to see two recently formed mixed hardwood and coniferous plantations, and also one of the estate nurseries on the Duke of Northumberland's property; and from Brinkburn the party travelled by rail to Morpeth, whence they took their departure to their respective destinations.

16. Forestry Exhibition at the Highland and Agricultural Society's Show at Peebles, July 1906.

By JOHN F. ANNAND, Overseer, Haystoun.

As in former years, the Society arranged a Forestry Exhibition in connection with the Highland and Agricultural Society's Show, which this year was held at Peebles. On the whole, both as regards extent and variety, the Exhibition of 1906 compared favourably with any of its predecessors. It was a little disappointing, however, to find that in a good forest district like Peeblesshire, only two of the landed proprietors in that county were exhibitors. There were sixteen competitive sections, and in most of these there were several entries.

A very important section was that in which some beautiful specimens of the timber of Scots pine, larch, and Norway spruce were shown. In this section there were eight competitors, the chief awards going to Sir Duncan E. Hay, Bart. of Haystoun, who had the first and third places, and to the Earl of Mansfield, who was second. The Arnott Trustees, Bandon, Co. Cork, who exhibited boards taken from trees of a much less age than the others, received a special award of a No. 2 Silver Medal in respect of the excellent quality of the timber and the skilful manner in which the boards were manufactured. A similar competition was that between the exhibitors of specimens of the timber of any three coniferous timber-trees, excluding the above-named sorts; and in this competition the first prize was won by the Duke of Buccleuch for a very excellent exhibit of silver fir, Menzies spruce, and Weymouth pine boards, while the specimens of Weymouth pine, Cembran pine, and black American spruce sent by Mr Steuart Fothringham of Murthly made a very good second.

Of no less interest and importance were the competitions in which specimens of the timber of broad-leaved trees were shown. One section was restricted to oak, ash, and Scots elm, and here again Sir D. E. Hay took the first and third prizes, the Earl of Mansfield being second. The oak and ash in the first and the elm in the second prize lots were of exceedingly fine quality. The elm in the third prize lot was somewhat faulty, the high average of this lot being due to the superior quality of the oak and ash.

Japanese larch, Norway spruce, Weymouth pine, Scots pine, and Douglas fir (Colorado and Oregon forms). The result of four years' growth showed that the lead was decidedly being taken by the Oregon Douglas fir and the Japanese larch, the European larch following up closely. He also sent samples of mature round larch and spruce timber from poor soil at 1100 feet elevation. Some of these stems measured up to 100 feet in length, and ranged in cubic contents (quarter-girth measure) from 50 feet to 75 feet each, timber to 6 inches diameter only being measured. From a young plantation of pure larch seventeen years old, on the same class of soil, he sent sample stems having an average height of 29 feet and a stem diameter at 4 feet 6 inches of $5\frac{1}{8}$ inches; and from a mixed plantation of larch, Douglas fir, spruce, and silver fir seventeen years planted, on similar soil, he sent average sample stems which showed the following measurements:—

	Height.	Diameter at Surface of Ground.	Diameter at 4 ft. 6 ins. High.
Douglas fir (green form),	38 feet	9 inches	$6\frac{3}{4}$ inches
Larch (European), .	30 „	8 „	$6\frac{1}{4}$ „
Spruce (common), .	28 „	6 „	$4\frac{1}{2}$ „
Silver fir (common), .	23 „	$5\frac{1}{2}$ „	4 „

The Society's collection of photo-micrographs of timber of British forest-trees attracted a good deal of attention, as did also a similar collection of eight hundred British and foreign ones exhibited by Mr James A. Weale, timber merchant, Liverpool.

Mr Balfour of Dawyck, Peeblesshire, had a small but very interesting collection on exhibition. He showed twenty-four distinct species of introduced conifers in pots, specimens of timber illustrating results of pruning, larch plants damaged by the pine weevil (*Hylobius abietis*), and a section from a large branch from one of the original larches planted at Dawyck. This branch contained excellent timber, and measured $2\frac{1}{2}$ feet in diameter. But probably the most interesting part of Mr Balfour's exhibit was that of the timber of three introduced conifers, namely, Douglas fir (*Pseudotsuga Douglasii*), green form, *Abies concolor*, and white American spruce (*Picea alba*). The timber was shown by complete cross sections of the stems and by planks taken from parts of the stems. The Douglas fir timber, and also that of *Abies concolor*, showed a remarkably large proportion of

autumn wood in the concentric rings, and was of specially good quality, clearly showing the possibilities for timber-production in this country of some of the western American conifers.

Lord Lamington sent an interesting exhibit of fencing stobs, creosoted by simply steeping them in an open tank; and the spruce, Scots pine, elm, beech, birch, and oak stobs so treated, which had been eleven to thirteen years in use, were in a remarkably good state of preservation.

Dr Borthwick sent a very complete and instructive set of herbarium specimens of British forest-trees; Mr John Smith, Peebles, a collection of specimen blocks of timber grown in Peeblesshire; Mr Gillanders, Alnwick Castle, a very complete set of cases of insects injurious to forest-trees; and Mr Robert Allan, factor, Polkemmet, sent larch stobs which were said to have been in use in a clay soil for forty-two years. They had not been treated in any way, and were in a remarkably good state of preservation.

Mr Adam Spiers, timber merchant, Edinburgh, had an interesting exhibit of planks of home-grown hornbeam, walnut, and common and Siberian larch; and he also exhibited Scots pine stobs which had been in use in a fence for forty years. The stobs had been thoroughly seasoned, and then steeped in boiling coal-tar.

Messrs Laing & Mather, Nurserymen, Kelso, very kindly sent, for decorative purposes, a collection of golden privet in tubs. These, grouped in various ways throughout the Exhibition, had a very pleasing effect.

The awards in the Exhibition section were as follows:—A Gold Medal to Mr Jas. A. Weale, and No. 1 Silver Medals to Sir Duncan E. Hay, Bart., Mr W. Steuart Fothringham of Murthly, Dr Borthwick, and Mr A. T. Gillanders.

A new feature of the Exhibition was that on each day a lecture was given on some subject connected with forestry. Mr Munro Ferguson, M.P., gave an address on "Instruction in Sylviculture"; Sir John Stirling-Maxwell discussed "The Planting of Waste Land"; Mr A. D. Richardson gave a paper on "The Larch Disease Fungus"; and Mr J. F. Annand gave a short paper on the "Quality of Timber, and how this may be affected by Cultivation." Some of the papers appear in the *Transactions*.

Altogether, the Exhibition at Peebles was a very instructive one.

17. The Forestry Exhibition at the Royal Show, Derby, 1906, and some of its Lessons.

By a CORRESPONDENT.

The Forestry Exhibition at the "Royal" was this year organised by the Council of the Royal English Arboricultural Society, under the personal supervision of Mr George Marshall.

The greater portion of the forestry exhibits was housed within a shed erected for the purpose, and associated with agricultural education, nature study, and school gardening; and the combination of these kindred exhibits was so full of instruction, both of a practical and scientific kind, that it would perhaps be difficult to say whether the direct knowledge gained from the forestry exhibit, or the indirect knowledge gained from the associated exhibits, was the more valuable. In the case of forestry, perhaps the indirect knowledge and indirect returns are more valuable than the direct. Judged from this standpoint, therefore, the Royal Agricultural Society acted wisely in combining agricultural education, nature study, and forestry in one united section.

As regards some of the more important exhibits connected with agricultural education, the Rothamstead Experimental Station had examples showing the effects of nitrogenous manures on various crops, under varying conditions, resulting from experiments lasting over many years, and illustrated by diagrams.

The Royal Agricultural College, Cirencester, arranged their exhibits under three heads, viz., Agricultural Chemistry, Geology, and Biology. Perhaps the last appealed most directly to the forester, inasmuch as it contained very good illustrations and examples of plant diseases, insects injurious to crops, ticks, lice, etc. As regards ticks, it may be noted that the study of these is now considered very important by the colleges, as they are very potent agents in spreading disease amongst animals.

The South-Eastern Agricultural College, Wye, showed some very good examples of living insects feeding on their respective host-plants. These were arranged by Mr F. V. Theobald, who has devoted considerable attention to, and has done some very important work in, this section of biology.

Cambridge University exhibits were under the supervision of

Professor Middleton, and included some interesting results in connection with the formation and improvement of pastures, and a species of disease-resisting wheat was shown.

The Royal Agricultural Society had a large exhibit, that from the Experimental Station shown by Dr Voelcker, and ably explained by his assistant, Mr H. M. Freear, being the most important portion for the forester. There was a very instructive set of pot cultures and diagrams; but perhaps the most instructive was an exhibit demonstrating the influence on wheat of soils of lime and magnesia in varying relative proportions. There was also an interesting exhibit showing the influence of lime in improving turf. It often happens that when planting is done on old pasture, and more especially on waste land, there is a spongy layer of half-dead grass immediately above the soil, which has a harmful effect on the young trees. If we use a fairly large-sized plant, say a 2-year 2-year Scots pine, it is not only partially buried, but this spongy layer prevents rain and moisture from reaching its roots. If, on the other hand, we use say 2-year 1-year Scots pine, and do the work thoroughly, it becomes necessary to remove a sod prior to planting the seedling. Hence both methods involve considerable expense, and court a proportion of failures. The spongy layer is acid in reaction, and contains nitrogenous matter derived from the decayed plant residues of which it is composed. The nitrogenous matter, however, is not directly available as a plant-food, but must first be converted into a soluble and available form by the action of the nitrifying organisms always present in fertile soil. When the soil is acid, the nitrifying organisms are unable to do their work; hence lime is applied to neutralise the acidity of the soil, and thus gradually to allow the nitrogenous matter to become converted into a soluble and available form. By the use of lime, then, the agriculturist causes the useless layer to disappear and the grass to improve; and the arboriculturist may do the same by the use of slag (which contains lime as well as phosphoric acid) on land of a clayey nature, and slag and kainit on poor soil, together with severe pasturing by cattle and sheep prior to planting. It is open to question whether, from a manurial point of view, the slag improves the young trees, but undoubtedly it improves the pasture, inducing the stock to eat the herbage closer, and therefore subsequent planting

can be more cheaply and better done. In short, it is the mechanical condition of the surface soil that is the all-important factor in planting, the slag being simply an agent for producing the desired results.

The Forestry Exhibition proper comprised seven sections, viz., (I.) Seeds and Cones; (II.) Trees and Shrubs; (III.) Woods and Plantations; (IV.) Timbers; (V.) Insects and Diseases; (VI.) Plans and Maps; and (VII.) Tools and Appliances.

In Section I., the Royal Agricultural College, Cirencester, and the Country Gentlemen's Association showed very good examples. In Section II., outside the building, the Duke of Northumberland had an exhibit and a small planted plot illustrating a sylvicultural mixture of light-demanding and shade-bearing trees, regarding which the following explanation was given:—"The number of plants per acre, and method of mixing, could be varied according to circumstances. The number per acre in this case was 4840, as set out on the plot, and the mixture consisted of—(*a*) an outer row of beech for shelter; (*b*) a second row containing a fair sprinkling of sycamore as a wind-resisting tree; (*c*) oak at 9 feet apart for the permanent crop; (*d*) other hardwoods for returns during the rotation; (*e*) a sprinkling of larch for early returns; and (*f*) shade-bearers of spruce, silver fir, and beech for soil-protection and stimulation of the main crop. The advantages of this method would be unbroken canopy throughout the period of growth, improved quality of timber, greater volume per acre, and at the same time this kind of mixing would make excellent fox and game coverts."

As regards mixing, it may be said that the method just mentioned cannot be claimed as perfect, but two important, though very elementary, points should be borne in mind, viz.—(1) that mixing should never be done in a haphazard way, and (2) that the idea that for game coverts the greater the chaos of trees, shrubs, grass, and weeds, the better the results, is a pure delusion. On the contrary, it is far better to form game coverts on sound sylvicultural principles, inasmuch as they will then yield genuine sport to the present owner and profitable woods to his successors.

In Section III. the Earl of Yarborough, who sent the largest forestry exhibit to the Show, had a very complete and instructive set of photographs of different kinds of trees in various stages,

from the nursery lines to mature crops of 120 years old, together with the methods of manipulating and creosoting the manufactured timber. Having regard to the brevity of human life, as compared with that of the trees, the photographs in question illustrated the fact that it is only by thus bringing together a series of individuals in their successive stages that we can get a view of the progressive development of a crop; and further, that first-class forestry can only be attained by a succession of good foresters co-operating with a succession of equally able owners.

In Section IV. the same exhibitor showed a very fine collection of timbers, both as sawn boards and as hand specimens, all beautifully mounted and carefully labelled. In addition to this exhibit, the Earl of Yarborough showed a very large collection of creosoted and uncreosoted wood grown in various soils and situations, together with a very elaborate exhibit of 158 different kinds of home-grown woods *naturally dried*, and then creosoted under pressure, all the kinds being treated at one operation, and the results obtained were tabulated on a large printed sheet. The Duke of Northumberland showed small samples of creosoted wood illustrating the creosoting of *naturally dried* wood by absorption, boiling, and under pressure respectively. The question of creosoting timber, when carefully studied, is more intricate and interesting than appears on the surface, but from a purely estate point of view, we derive from the exhibits of these two noblemen three important lessons, viz.—(1) that as timber *must be thoroughly dried before it is creosoted*, natural drying is the best *estate* method of preparation; (2) that all kinds of timber take in more or less creosote; and (3) that, according to circumstances, each of the methods—pressure, boiling, and absorption—may give good results.

In Section IV. the Duke of Northumberland showed specimens illustrating the effect of dense and of thin crops in branch suppression and on the quality of the timber. Two of the examples sent in may be noted. A large portion of a stem taken from the centre of a pure Scots pine wood 70 years of age, showed the evil effects of too early thinning. The clean portion of the base of the stem was no doubt the result of thick planting, and the thick branches seen at the top were probably produced in consequence of the plantation having

been thinned too early. The commercial value of the crop was therefore very much depreciated. Contrasted with this there was another section of a stem showing the advantages of deferred thinning, and the following is a copy of the description which accompanied it:—"Section of spruce tree taken from a portion of a 45 year old pure wood, now containing 632 trees to the acre, with cubic contents (true measure) of 6000 feet. Section taken 10 feet from base. Total height of tree, 53 feet. Cubic contents, 10 feet. The trees were originally planted at 3 feet apart, and only dead and very heavily suppressed trees have been cut out. This shows the advantage of deferred thinning, as the increment amounts to $133\frac{1}{3}$ cubic feet per acre per annum. The average increment of the whole wood (about 100 acres, on moorland peaty soil) is over 100 cubic feet per acre per annum. It is therefore a very valuable crop for estate purposes."

There were other exhibits of a varied and interesting nature, some of the principal being a collection of British timbers from the Earl Egerton of Tatton, Tatton Park, Cheshire, and specimens of home-grown commercial woods and similar products of the Colonies and of the United States.

In the remaining Sections were well represented a variety of exhibits, viz., insects on trees, fungi injurious to trees, working plans, books on forestry, etc.

As regards nature study, the exhibits consisted of specimens of work actually done in rural, elementary, and secondary schools. The exhibits sent in by the Lea and Cromford schools, Derbyshire, were very fine indeed. It is almost impossible to exaggerate the beneficial character of this training of the youthful mind. It will no doubt have an important influence on the future welfare of the people, while at the same time it must have important bearings on forestry, inasmuch as any youth receiving a training of this sort prior to beginning the study of practical and theoretical forestry cannot fail to have developed two important faculties, viz., those of observation and deduction.

REPORTS BY THE HONORARY SCIENTISTS.

1. *Report by* A. W. BORTHWICK, D.Sc., *Honorary Consulting Cryptogamist.*

Although the queries received during the past year have been slightly more numerous than usual, still, there was nothing of special interest which has not been dealt with in former Reports, and consequently need not be repeated here. It might, however, be mentioned that specimens of Japanese larch attacked by the larch canker fungus have been received from different places. One or two specimens, which have recently come in, are still under investigation and will be reported upon later.

2. *Report by* R. STEWART MACDOUGALL, M.A., D.Sc., F.R.S.E., *Honorary Consulting Entomologist.*

The feature of the year as regards forest insects has been the extended attack on larch in Cumberland by the larvæ of *Nematus Erichsoni*, the Large Larch Sawfly. A full account of this insect and its work appears elsewhere in the *Transactions.*

Inquiries also reached me as to the larch aphis, the pine beetle (*Hylesinus piniperda*), and the large pine weevil. From several sources the giant wood wasp was sent. The caterpillars of the pine sawfly (*Lophyrus pini*) were here and there troublesome, and Mr F. Moon sent me material of *Lophyrus rufus*, the larvæ of which had proved pestiferous. Useful ichneumon species were received from various places for determination. From Mr G. Brown, Beauly, came a specimen of the death's head moth.

One of the troublesome insects of the year was *Retinia buoliana*, the pine shoot twister. From both Scotland and England complaints of the damage done by the caterpillars of this little moth reached me. The moth lays its eggs in July or in late June, on the buds of young pines, the eggs being laid singly. The larvæ overwinter as small caterpillars, and renew their feeding in the next spring, tunnelling in the buds and young shoots. Pupation is generally in June. The only practicable measure against the pest is the timely cutting off and burning of the infested shoots. This is a measure worth practising, from the tendency of the moth to spread. Mr James M'Callum, Canford Manor Estate, Dorset, who sent me material in the month of June, found that with him Scots pine was worst attacked, and then Austrian pine, Corsican pine, and *Pinus insignis*. Mr M'Callum had also Douglas fir infested. This last is an important observation, being, as far as I know, the first recorded attack of *Retinia buoliana* on Douglas fir.

NOTES AND QUERIES.

Sylvicultural Experiments at Novar.

The larch experiments at Novar originated from an acre plot of mixed larch and Douglas fir casually planted twenty years ago on a corner of shingly arable land of small agricultural value. After a dozen or fifteen years of fast growth, the larch was singularly free from aphis and blister. Patches of larch with which natural beech was intermingled were also comparatively immune; and so the question presented itself whether larch should be grown pure or mixed, and, if mixed, then how? That is the inquiry pursued here on empirical lines, but always on the assumption that thick screens of shade-bearers round larch in clumps or singly tend to hinder the distribution of the spores of *Peziza Willkommii*.

Alongside of these experiments there has been the alternative two-story policy, already admirably described in the *Transactions*, which consists of a larch crop underplanted with shade-bearers at 15 or 20 years old. It is the opinion of those who have managed these plantations for 25 years, that this system promises well wherever larch comes away freely and is likely to mature, as to which there has been no difficulty for the last 130 years at Novar. It is true that it is a system evolved by comparatively ignorant persons, yet in this particular enterprise empirical judgment is probably more reliable than that of any expert. For experiments of any kind in preventing larch disease, save by thin cropping or mixed plantations, is extremely limited; exotic Coniferæ have never before been grown so cheaply as to permit their use in sylviculture; while little can be taught even in the country of sylviculture, larch being seldom seen in Germany from Berlin to Hamburg or from Dresden to Strassburg. At any rate, experimental results at Novar promise so well that many hundred acres of pure larch will be treated in the manner already described, with the object of getting the largest combined crop

of larch and shade-bearers to produce the best quality of all classes of timber.

It may be interesting, further, to describe the alternative series of experiments in mixed plantations designed rather to protect larch from disease than with regard to the fate of other varieties employed. These were initiated by Colonel Bailey, and through his advice a number of plots were formed of such mixtures as larch, beech, spruce, and silver fir; Scots pine with larch at 20 feet intervals, pitted and notched; spruce and larch; larch pitted and notched in adjacent lots. The experiments in notching and pitting were designed to ascertain whether, by quicker growth in the pits, the larch would more readily escape disease; there is little difference in the result after seven years' growth, and the cost of pitting and notching is respectively as £2, 19s. 6d. to 13s. 9d. the acre. Both systems are now practically abandoned for dibbling two-year seedlings.

The silver fir, on which Colonel Bailey most properly relied for larch mixtures, was raised in great numbers, but it became useless from aphis: this disaster led to much delay and to some years of nursery work to find substitutes, spruce being too slow and not the best shade-bearer, and beech too uncertain in value for general use. After six or eight seasons, Douglas fir, Menzies spruce, *Tsuga Mertensiana*, *Thuya gigantea*, *Abies grandis*, and Lawson cypress were selected as the most promising varieties for ordinary sylviculture; the cost of some of them does not much exceed that of Scots pine and spruce. Others are still being tried. Some two hundred acres of larch are more or less mixed with these Coniferæ; in part both species are planted simultaneously, in part blanks among pure larch are filled in with shade-bearers, in part a designedly-thin crop of larch is filled in with shade-bearers after the lapse of two or three years, which gives it, as a light-demander, the right amount of start. The value of this work is yet to be determined, but it is plain, from the 20-year-old plot, that a mixture of larch and Douglas fir produces a heavy crop of excellent timber of both kinds, that the Douglas fir is not sufficiently cleaned, and that, if the race is close, the Douglas fir inclines to be too swift. It is still too soon to say whether, if the larch is given a start, the leaders of the shade-bearers will be sufficiently clear, but this seems likely. This mixture well deserves trouble, especially where the larch needs help on second-class larch soils. The mixture of Menzies

spruce and larch should succeed, giving the larch a start of two years, the leader of the spruce being very persevering. Larch is certainly too quick for mixing with *Thuya gigantea* and Lawson cypress, while of all simultaneous coniferous mixtures with larch, probably *Tsuga Mertensiana* will give least trouble, for even if it gets away first, the unassuming leader of the hemlock does not interfere with the larch, and its side branches are less persevering than those of the Douglas fir, while *Tsuga Mertensiana* is liable to be kept back by frost-bite at the earliest stages of its growth, which gives the larch a start, and, like the Lawson cypress, *T. Mertensiana* is greatly appreciated by a hare or rabbit. The general disadvantage of filling in blanks with shade-bearers is that, if these tend to make larch strong and healthy, their shade hampers subsequent effort to replace fresh blanks or to underplant. As in the case of any mixture, the shade-bearers do not clean themselves properly, and the plantation, especially in the absence of trained foresters, is hard to thin. To produce the minimum of disadvantage is naturally the object of these experiments. Among the acre plots formed three years ago are larch mixed with cypress and hemlock, and plots have been planted with half a crop of larch, to be filled in with Menzies spruce and other species. There are half acres also of Japanese larch, pitted and notched; it grows extremely well, but as the Tyrolese larch is sufficiently prosperous, and the value of its timber is better known, very few of this species are being used in the woods except for appearance' sake and to fill up blanks in Tyrolese larch, since the Japanese spring away somewhat quicker after planting. Other plots are being formed, such as of oak and larch; oak, beech, and larch; Spanish chestnut and larch. It may be noted, as regards the more ordinary assortments, that in mixing larch with Scots pine the former is apt to be blown crooked as it rises above the pine, when it also damages many neighbours. Blanks in spruce filled with larch a few years after planting promise well. Larch with spruce and Scots pine is a mixture which needs the bill-hook fairly early, and is difficult to manage. It is best to clump the larch on suitable soil, surrounding them with screens or clumps of other varieties. If larch clumps on soils of first-class larch quality are large enough, they can be eventually underplanted, should that system, as seems probable, predominate over other methods of larch culture.

R. C. MUNRO FERGUSON.

Experimental Plots at Novar.

(Extracts from a Report by Clive Marriott.)

The land has been carefully laid out and planted, each plot consisting of two acres, though a good many of them have been subdivided. The two-acre plots are separated by narrow rides. The soil throughout almost the whole area is good, though the northern portion is best and richest. The former old crop of larch grew to an enormous size, and produced extremely fine timber of high quality. Most of the present plants have been in the ground for three to five years.

Larch and *Thuya gigantea*.—The two acres are equally mixed, planted 3 feet 6 inches apart, and were stocked at the same time. The larch looks very well and seems healthy, but the *Thuya* is of a bad colour, and there are some deaths. The larch is predominating, and it is probable that the *Thuya* will not thrive well until it obtains a certain amount of shelter from the larch.

Abies grandis.—The whole two acres are pure *Abies grandis*, planted 3 feet 6 inches apart. The plants seem healthy and strong, but there are some deaths, and the growth is not very good. It is noticeable that the plants do not look nearly so well as those growing in the shade, where they have been used for underplanting.

Tsuga Mertensiana (*Albertiana*).—One acre of larch and *Tsuga Mertensiana* equally mixed. The larch looks well and healthy, and shows good growth. Among the *Tsuga* there are many deaths and stunted plants. A few of the plants look well and show a good growth, but there is a marked difference between them and the young trees used in underplanting. The *Tsuga* appears to require some shelter.

Tsuga Mertensiana, pure.—One acre of pure *Tsuga Mertensiana*. This plot is not very thriving; there are many deaths and blanks, and the area will have to be replanted. On the extreme north side, however, the trees look better and show good growth; this, again, points to their requiring shelter, as on the extreme north the hill-side and trees give a considerable amount of protection.

Pseudotsuga Douglasii.—The two-acre plot is divided into two portions. One acre is planted with pure Douglas fir, and the other with Douglas fir and larch mixed. The pure Douglas fir show most splendid growth; there are very few deaths, and the

trees look remarkably fine and healthy. On one plant I measured last year's leader, and found it 2 feet 6 inches long. In fact, the whole plot is remarkably satisfactory.

Larix leptolepis (Japanese larch).—This plot is situated at the extreme west of the experimental plots; it is divided into two parts by a narrow ride, and has been planted six years. The trees are a good height, and seem very strong and well. There have been very few deaths, and the whole plantation looks flourishing. It is claimed for the Japanese larch that it is very strong, and better able to resist the attacks of the deadly larch disease than the native larch. This may be so, but the larch disease is present in the plot even at this early age, though in a very slight degree, and time alone will show the disease-resisting qualities of this tree.

[Mr Marriott has sent specimens of diseased Japanese larch. A further report on the progress of the disease in this plot will be welcome.—HON. ED.]

ESTATE-CONDUCTED EXPERIMENTS IN SYLVICULTURE AND OTHER BRANCHES OF FORESTRY.

The writer strongly advocates an extended and more systematic testing by local experiment of various methods of sylvicultural treatment, of various measures of protection against hostile influences, and of other acts involved in the successful raising and utilisation of crops of trees. Such experiments, if carefully conducted, the results being intelligently observed and accurately recorded, would not only add to the knowledge and professional efficiency of those who conduct them, but, if made widely known through the medium of our *Transactions*, would also prove of great value to others who are engaged in similar work.

Many most useful and instructive experiments or investigations may be satisfactorily carried out on quite a small scale. For example:—The comparative efficacy, in a certain locality, of the planting in pits, notches or dibbled holes of plants of different species and of various ages or sizes, may be tested by means of a few short and adjacent rows of plants, from the progress of which the results may be seen and compared at a glance. An experiment in direct sowing, on ground where the digging of

pits or other holes presents difficulties, owing to the shallowness of the soil, the water conditions, or other cause, may be made on a very small area. So also may the planting of weed-encumbered ground with shade-bearing and quick-growing species (such as Douglas fir), or other means of stocking such ground, be put to a practical test; while various methods and degrees of pruning hardwoods may be practised on groups of trees very limited in extent.

Again, the degree of shade which, under local conditions, each of the more important exotic conifers is able to bear, and the place which each of them should occupy in a graded list of shade-bearing capacity which included our British forest trees, could be determined by experiments on a very modest scale. The knowledge thus acquired might be applied to determine the relative suitability of all these species for the under-planting of light-crowned crops, and the age and degree of density of the latter found to be most suitable under the circumstances of the locality; while the suggested investigation could easily be extended so as to include the treatment of larch disease. A commencement might be made to test the suitability of each of these species for cultivation as a forest crop in this country.

Other experiments which could be conducted equally easily might be:—The testing of the capacity of certain exotic species to grow in high, wind-swept situations, to act as wind-breaks, or to flourish by the seaside when exposed to gales accompanied by salt spray; the protection of young plants of tender species from injury by frost (see an article by Geo. U. Macdonald at p. 287 of Volume XIX. of the *Transactions*); the combating of attack under various conditions by insect or fungoid pests, or by game or vermin; and the promotion of natural regeneration by exposing the mineral soil in patches or strips, or by other means.

The above and many other investigations and experiments could be carried out on a small but sufficient scale in the ordinary course of work, either without additional outlay, or at a trifling cost; but the results could not fail to be of great value to all engaged in forestry, and they would certainly well repay the trouble expended on them.

It is, however, very desirable that, on every considerable forest estate, a conveniently situated area should be devoted to experiments and investigations on a somewhat larger scale than

has been suggested above. The cost, which might still be very moderate, would be recouped many times over by the gain of practical knowledge to be applied in the management of estate woodlands; while the "garden" could not fail to become a source of interest to the owner, as well as to the whole of his estate staff. Indeed, if costly mistakes are to be avoided and financial success to be secured, such investigations should precede all extensive operations, and should form an essential feature of the ordinary business on a timbered property. Every important industry is nowadays guided by analogous investigation; brewers and other manufacturers pay large sums for chemical analysis or other researches conducted in order to keep their knowledge up to date, and thus to secure a sound economic basis for their business. Expenditure thus incurred is looked upon as a part of the current outlay, and as essential to commercial success.

Can those who are responsible for the management of British forests afford to neglect, or to unduly curtail, any reasonable means of deepening and widening the foundations on which their important industry rests? F. B.

The Rate of Growth of *Pseudotsuga Douglasii* in the Woods of Saxony.[1] (Communicated by John Booth.)

It deserves to be more widely known in forestry circles that Prince Bismarck interested himself to a high degree in the introduction and cultivation of exotic species of trees, and that it is in part owing to his initiative that for some time the Prussian State Forestry Administration has carried out cultivation experiments on a large scale. Influenced by the celebrated Mr John Booth, the Prince also had experimental plots established over a still larger area in the woods of Saxony especially with the object of making experimental cultures of *Pseudotsuga Douglasii.*

The first yearling plants of this species were introduced in the year 1878 by Mr Booth into the woods of Saxony, and were placed in nurseries. In the year 1881 the then four-year-old trees were planted out in the first experimental plot.

[1] Translated from the *Zeitschrift für Forst- u. Jagdwesen*, p. 8, 1906.

For this purpose a plot, which had been for two years used as an enclosure, was utilised, the soil being a humus-containing, gravelly, and somewhat loamy diluvial sand (valued in the estate books as a spruce soil of Class III.). Here a total area of 0·47 hectares,[1] protected at the sides by old timber, was planted, half with four-year-old Douglas fir in 1·5 metre squares, and half with spruce in 1·2 metre squares.

The amount of timber on this plot, which has not yet been cleared, has now been calculated by means of a careful survey. The accompanying Table gives an interesting view of the growth-relations on the two experimental plots.

Douglas Fir. Age, 29 years. Area planted, 0·235 hectares.						Spruce Fir. Age, 29 years. Area planted, 0·235 hectares.					
Thickness at breast-height.	Number of Trees.	Height.	Area of basal trunk section.	Cubic Contents.		Thickness at breast-height.	Number of Trees.	Height.	Area of basal trunk section.	Cubic Contents.	
				Per Tree.	Total.					Per Tree.	Total.
In cm.		In m.	In sq. m.	In cub. m.	In cub. m.	In cm.		In m.	In sq. m.	In cub. m.	In cub. m.
4	5	8	0·006	0·01	0·05	4	95	6	0·119	0·01	0·95
6	162	10	0·458	0·02	3·24	6	368	8	1·040	0·02	7·36
8	99	12	0·498	0·03	2·97	8	405	10	2·036	0·03	12·15
10	118	14	0·926	0·06	7·08	10	297	10	2·333	0·04	11·88
12	120	16	1·357	0·09	10·80	12	120	12	1·357	0·07	8·40
14	129	17	1·985	0·12	15·48	14	50	14	0·770	0·10	5·00
16	90	18	1·810	0·17	15·30	16	15	14	0·302	0·13	1·95
18	69	18	1·756	0·22	15·18	18	4	16	0·102	0·18	0·72
20	50	19	1·571	0·28	14·00	20	1	16	0·031	0·23	0·23
22	6	19	0·228	0·34	2·04	...	...	...	...	...	...
24	12	20	0·543	0·40	4·80	...	...	...	...	...	...
26	7	21	0·372	0·49	3·43	...	...	...	...	...	...
28	1	22	0·062	0·59	0·59	...	...	...	...	...	...
32	1	22	0·080	0·72	0·72	...	...	...	...	...	...
...	869	...	11·652	...	95·68	...	1335	...	8·090	...	48·64

If the results be reduced to 1 hectare, then we have—

Douglas fir, total area of basal trunk sections,	49,583 sq. metres.
Spruce, total area of basal trunk sections,	34,426 sq. metres.
Douglas fir, total yield of wood,	407 cubic metres.
Spruce fir, total yield of wood,	207 cubic metres.

The wood of both plots could now be used for poles, and in part as small pit-timber. An estimate of the market value

[1] 1 hectare = 2·47 acres.

of the crop, according to the prices now quoted in this country for firewood, works out at about 1000 marks for the Douglas fir and about 360 marks for the spruce. The above statements thus show that, when growing on the same soil, the Douglas fir, as compared with the spruce, yields about twice the amount of timber, with about three times the value. In reality the results are even more favourable to the Douglas fir, for present observation and experience show that its wood far surpasses that of the spruce in quality, and consequently higher prices are to be expected for it.

The results of the experiments on the cultivation of the Douglas fir thus justify to their fullest extent the favourable impressions which this species has everywhere made (see John Booth, *The Introduction of Exotic Species of Trees;* and the May number, 1901, of the *Zeitschrift für Forst- u. Jagdwesen*), and awake the wish that its cultivation should be extended over a larger area than at present in the great forest regions.[1]

THE HEAD FORESTER OF TITZE-FRIEDRICHSRUH.

AFFORESTATION OF THE TALLA WATER-CATCHMENT AREA.

We are glad to learn that the Edinburgh and District Water Trust are considering the afforestation of the Talla water-catchment area. This work, if successfully carried out, would tend to secure a regular supply of pure water for the use of the city, and the forest would, no doubt, be made available as a much-needed training ground in practical forestry. Municipal forests, like State forests, are not exposed to all the vicissitudes which are inherent in forests under private ownership; and a well-managed municipal forest in the vicinity of Edinburgh would greatly facilitate the training of students of both the University and the College of Agriculture, while it would, at the same time, afford a valuable example of modern scientific forestry, which would be taken advantage of by landowners and others interested in the important question of profitable forestry. The forest would ultimately yield a steady revenue to its owners. HON. ED.

[1] See also the *Zeitschrift für Forst- u. Jagdwesen*, 1905, p. 282, "The Rate of Growth and Timber of *Pseudotsuga Douglasii* in Germany," by Professor Schwappach.

The Midland Reafforesting Association.

From the Report for 1905, the third year of its work, this Association would appear to be making substantial progress. At the first annual meeting its membership was 94; now, as the result of an "Appeal" issued in October last, over the signature of the president, Sir Oliver Lodge, it stands at 260. Financially, too, good progress is being made, for it is pointed out that whereas a year ago nearly all the members paid the minimum subscription of five shillings, very many now contribute a guinea or more. Current expenses are charged against subscriptions, and donations go to form a permanent fund from which advances may be made for planting, and to which all such advances are to be repaid as each planting contract is completed.

The Association was formed as the result of a public meeting held in Birmingham on February 12, 1903, for the purpose of promoting the reafforestation of waste land, including pit-tips and spoil-banks, more particularly in that part of the Midlands known as the Black Country. It seeks to attain its object by convincing the public that its plans are feasible, and by making "the knowledge gained from previous attempts, their successes and their failures, the basis of a Great Public movement, which shall restore to the district some of its ancient beauty, and render back its waste places to the service of men"; and its views are disseminated through the Press, and by means of pamphlets and lectures. It is also prepared to give expert advice to those intending to plant on their own account, and, where opportunity offers, to form model or demonstration plantations. The establishment of Branches (three have now been formed) is also one of the methods by which the Association prosecutes its work.

But the most important of the work undertaken by the Association is the planting of waste land. It is estimated that there are 30,000 acres of waste land in the Black Country, and of this 14,000 are immediately available for planting purposes. The Association contracts for the planting of this waste land at the rate of £5 per acre, including both plants and labour; in some cases it also fences the plots at a price agreed upon. Progress is, of course, slow, but a considerable area has already been planted, and a feature of interest in connection with this work is that "during this past winter a considerable sum has

been paid, in well-earned wages for remunerative work, to casual labourers who might otherwise have swelled the ranks of the Unemployed."

A good map, prepared by Mr P. E. Martineau, whose services as Organising Secretary have been secured, accompanies the Report, and from this an excellent idea of the very large proportion of the surface of this part of the country which is covered by these pit-mounds and spoil-banks may be obtained. Photographic illustrations are also given to show the transformation which has been effected on some of the pit-mounds by planting, and to prove that, though conifers and oaks do not take kindly to the atmospheric conditions, willows (of which a large number have been planted), birch, alder, and many other hardy kinds of trees thrive quite well under the conditions prevailing in the Black Country. An appeal for willow cuttings in September last met with a cordial response, and His Majesty the King has shown his interest in the Association's work by a donation of twenty thousand of these from Windsor Forest.

The Honorary Consulting Forester to the Association is Professor W. R. Fisher, B.A., Oxford, and the Secretary is Mr Hubert Stone, Bracebridge Street, Birmingham.

A. D. R.

The Denbighshire Scheme for an Experimental Station.

Under the title *A Word on Forestry and the Denbighshire Scheme for an Experimental Station*, the leading features of the above scheme have been set forth by Mr John Mahler, of Chirk, in a small pamphlet, published in September 1905.[1]

After some references to the finding of the Departmental Committee on Forestry (1902), relating among other things to the suitability of the British climate for timber-growing, the likelihood of a shortage in our timber imports in the near future, the necessity for additional facilities for theoretical instruction and practical demonstration in forestry, the demand for demonstration areas under State or corporate control, and the desirability of illustrating collegiate instruction in forestry by means of

[1] Oswestry: Woodall, Minshall, Thomas & Co., Caxton Press.

"example plots," Mr Mahler goes on to show how, under the Denbighshire Scheme, corporate control by the county council and scientific management under Mr Fraser Story, the lecturer on forestry at Bangor, will be obtained in the working of their forestry station, which will at the same time serve the purpose of a demonstration area to the forestry students at the North Wales University College and other teaching centres.

The plot of land selected for the experimental station is situated at Pontfadog, near Chirk. It lies between the 900 and 1200 feet contours, and it has an aspect extending from north to south-east. According to Mr Fraser Story's report, extracts from which are given by Mr Mahler, the soil and situation are "typical of a great deal of land in Wales which ought to be afforested," the area is well placed as regards roads, and there is probably a considerable demand for pit-wood in the district.

As regards the nature of the experiments which might be made, Mr Story mentions the following:—

1. The planting of indigenous and exotic species in such a way as to test their comparative suitability for the ground, and their rate of increment and timber value; and the comparative advantages of pure and mixed plantations, and of even and uneven aged woods.
2. The various methods of planting, such as "slit" or "notch" planting, "vertical notch" planting, "pitting" with the spade and mattock, and so forth.
3. The various ages at which seedlings and transplants should be planted out, and the best planting distances, taking cost into account.
4. The investigation of different kinds of sylvicultural treatment of timber crops, including various systems of thinning and underplanting, and the comparison of dense and "open" woods, etc.

The Denbighshire and University College authorities are to be congratulated on the acquisition of this important adjunct to the equipment of the lecturer on forestry, and it is hoped that this laudable effort in the furtherance of the teaching of the subject will be promptly followed in other parts of the country.

A. D. R.

Estate Forest Museums.

In an article which appeared recently in the *Indian Forester*, the formation of local forest museums is strongly advocated, and the writer of the following note trusts that the day is not far distant when no considerable forest estate in this country will be without its small museum, the contents of which have all been obtained in the local woods.

The collection would include, among other objects, the following, viz.: Specimens of insects and fungi (each in its various stages) which attack the forest crops—these being required to facilitate the recognition and suppression of the pests; Specimens of diseases and defects due to other causes; Examples of damage by fire, snow, hail, or other injurious phenomena; Specimens illustrating the quality of the timber of various species produced on the estate; Articles manufactured on the estate, including timber creosoted, or otherwise treated with the object of increasing its durability. Specimens of the buds, leaves, flowers, seeds and fruits of forest trees (including exotic species which may not yet have been established as such), with a collection of dried seedlings in their successive stages of development, would form a useful and interesting addition to the above.

The Society's Honorary Scientists would, the writer feels assured, willingly identify objects submitted for their examination.

The accommodation necessary for such a museum would be on a very modest scale; a small room in some out-building, furnished with a deal table, a chair and a few shelves would satisfy all requirements. And the equipment required would be correspondingly limited—a few glass-stoppered bottles, some methylated spirit, a collecting-box and one or two books of reference would afford a good start, and the cost of these would be trifling. Measures should of course be adopted to effectually protect the building and its contents against risk of destruction or injury by fire.

At first, no doubt, a good many objects would be brought in; but later on, additions to the collection would obviously be made more rarely, and the time occupied in forming the little museum would not be found to interfere with the ordinary duties of the forester.

On the other hand, the following, among other important

advantages, would accrue from the establishment of the suggested museum:—

1. Improved efficiency of the staff—(*a*) By increased ability to recognise forest pests in all their stages of development. (This they are not now in all cases able to do—not through any fault of their own, but by reason of the absence of means of acquiring the necessary knowledge.) (*b*) By development of their powers and habits of observation. (*c*) By increase of interest and pleasure in their work generally; and by new attractions found within the woods, with the consequent inducement to spend more time in them. The small cost of the museum would be covered many times over by the increased efficiency thus promoted.
2. A further advantage lies in the collection, at numerous points throughout the country, of objects relating to forestry, and regarding which information can readily be communicated to others through the Society's *Transactions*, and can thus be made a source of mutual benefit to all engaged in the industry of timber-growing.

A commencement in the direction above suggested has already been made on a few estates. These need development; but the good example thus set should now be followed by all who desire to practise forestry as a profitable industry. F. B.

Irish Forestry Station.

The family seat of the late Mr Parnell at Rathdrum, purchased by the Department of Agriculture recently, is now being used as a training ground for foresters. At the present time there are thirteen students, most of whom have previously been engaged in forest work or gardening. Special lectures are given them in one of the rooms of Mr Parnell's house, principally in the evenings and at odd times. During the remainder of the day they are engaged in cutting down timber, dressing it, or planting, according to the season of the year. Besides their instruction, these men receive a wage of 16s. per week during the first year, 18s. during the second, and 20s. during the third year.—*The Timber Trades Journal.*

Forestry Instruction at Armstrong College.[1]

An important advance in the development of the forestry branch of Armstrong College, Newcastle-on-Tyne, has been effected by an agreement between H.M. Office of Woods and the College authorities, under which the latter take over the local management of Chopwell Woods, in the county of Durham. These woods, which are within a few miles of the College, extend over an area of nearly 900 acres, and carry crops of larch, spruce, Scots pine, oak, ash, and other trees, most of which were planted about fifty years ago. The woods will be gradually brought under a proper rotation of cropping by the clearing and replanting of the more mature portions from time to time, and the carrying out of this work will afford favourable opportunities for demonstrating the various operations relating to practical forestry.

Mr J. F. F. Horner, H.M. Commissioner of Woods, has obtained the consent of the Treasury to a house being provided in the woods as a residence for the College lecturer in forestry, Mr A. C. Forbes, and to continue to pay as heretofore the ordinary working expenses of the woods. The arrangement will facilitate the holding of short courses for practical foresters and others desirous of acquiring a knowledge of the subject, while as a practical demonstration area for the students attending the College forestry class the woods will be invaluable, and should render Newcastle an excellent centre for forestry instruction.

[Scotland is still without a Demonstration Forest, or even a Forest Garden.—Hon. Ed.]

Dean Forest School of Forestry.

The Department of Woods and Forests has intimated that a fourth class, for students between the ages of sixteen and twenty-three, is to be started early in November. Instruction is given free, and extends over two years. Wages are at the rate of from 8s. to 10s. per week, on the principle of no work no pay, but students would require from 5s. to 7s. in addition from private sources. Further particulars upon application to the Secretary of this Society; or to the Office of Woods, 1 Whitehall Place, London, S.W.

[1] Reproduced from the *Journal of the Board of Agriculture* for June 1906, by permission of the Controller of His Majesty's Stationery Office.

Appointments by the General Post Office.

The General Post Office has created four new posts of "Assistant Pole Inspector" in connection with the supply of telegraph poles for use by the Department. Candidates must be between the ages of twenty and twenty-five years. Salary commences at £100, and rises by annual increments of £6 to £140. Assistant Pole Inspectors may be selected for promotion to the class of Pole Inspector, on £150, rising by annual increments of £10 to £220. Further information may be obtained on application to the Secretary of this Society.

Hon. Ed.

Demonstration Forest for Scotland.

On the 20th June, in the House of Commons, Mr Herbert Roberts asked the following question:—What steps have been taken to carry into effect the recommendation of the Departmental Committee of 1902 on British forestry; and whether any communication has been addressed to corporations and municipalities relative to the Committee's recommendation as to the desirability of planting with trees the catchment-areas of their water supply?

Replying on behalf of the President of the Board of Agriculture, Sir E. Strachey said:—1. The Departmental Committee recommended that the Alice Holt Woods, in Hampshire, should be made available as soon as possible to serve as a demonstration area in England. This has been done. A full report as to the past history, present position, and future management of these woods has been prepared by Dr Schlich at the request of the Commissioners of Woods and Forests, and the recommendations made therein are being systematically carried out. A certain amount of experimental planting has already taken place. Copies of Dr Schlich's report, illustrated by plans, can be had on application to the Commissioners. *It was also recommended that a suitable estate should be purchased in Scotland to serve as another demonstration area. Several properties have been brought to the notice of the Commissioners of Woods and Forests, but,*

for various reasons, they did not appear suitable for the purpose. Two additional properties are now under consideration, and as soon as a suitable estate has been found the Treasury will be approached with a view to purchase. 2. The recommendation of the Departmental Committee that lecturers should be appointed at Oxford and Cambridge has to some extent been met by the augmentation of the salary of the Sibthorpian Professor of Rural Economy at Oxford, who is now Professor of Forestry Botany. It is understood that an estate will be placed at his disposal for demonstration purposes. 3. A sum of £500 a year, which was placed by the Treasury at the disposal of the Board for the establishment of lectureships in forestry, has been allocated to the University College of North Wales at Bangor and the Armstrong College at Newcastle-on-Tyne. The results have been most encouraging. A considerable number of students have been found desirous of taking a full collegiate course of study, good classes of practical foresters and others have been conducted at selected local centres, while there has been a constant demand on the part of landowners for expert advice from the lecturer. 4. A school for working woodmen has been established by the Commissioners of Woods and Forests in the Forest of Dean, and is now in the third year of its existence. From eighteen to twenty youths are receiving instruction. 5. Legislation would be necessary to remove the inequality in the levy of the estate duty on timber, and it has not been possible hitherto to take any steps in this direction. The matter has, however, not been lost sight of. 6. "The Railway Fires Act, 1905," which comes into force on January 1, 1908, will give some protection to owners of woods against loss by fire caused by sparks from locomotives. 7. Special inquiries were made in 1905, with a view of ascertaining the extent of land now occupied by woods in Great Britain, and the results have been published in the Agricultural Returns for that year. The three categories suggested by the Departmental Committee were adopted. 8. With the object of ascertaining the districts in which local authorities have developed the catchment-area of their water supplies by afforestation, the Board communicated with the Local Government Boards for England and Scotland, who sent out a circular letter to all local authorities asking for a return. The results were tabulated and published in the *Journal of the Board of Agriculture* for November 1904. A leaflet on the "Relation of Woods to Domestic Water Supply" was

published in January 1904, and a large number of copies have been issued. The Board are keeping the various recommendations of the Departmental Committee steadily in view, and they hope to be able from time to time to proceed further in the directions indicated in their Report.

[The above ministerial statement is very welcome, especially that part of it which relates to Scotland, and which is here printed in italics.—HON. ED.]

RESEARCH AT THE INDIAN FOREST SCHOOL.

The following Resolution has recently been published by the Government of India:—

"The Government of India have had under consideration the desirability of making better provision for scientific research in connection with Indian forests. They cordially acknowledge that the work of the Forest Department has been characterised by marked and progressive development, which has resulted in an improved condition of the standing timber, and in a satisfactory increase in the net revenue derived by the State from its forests, while due regard has been paid to the interest and needs of the population residing in their neighbourhood, and to the requirements of the future. The energies of the Department have, however, hitherto been largely confined to the practical management of the forests under its charge, and comparatively little attention has been directed to the work of research, which has been pursued with such beneficial results in other countries. In order, therefore, to provide a staff of experts who will be in a position to devote a large proportion of their time to the prosecution of scientific research connected with forest produce, as well as to give the best available training to candidates for the forest services, both of British India and of Native States, they have, with the sanction of the Secretary of State, decided to raise the status of the existing Imperial Forest School at Dehra Dun, and to add to its staff. The school will now be known as the Imperial Forest Research Institute and College, and the staff will include six officers of the Imperial Service holding the following posts:—

"(1) An Imperial Sylviculturist, who will make sylviculture his

special study. (2) An Imperial Superintendent of Forest Working Plans, who will collect and collate statistics of the results of forest management throughout India, which are provided by the control forms annually submitted to the Government of India, so that the valuable information required in the different provinces will be made available to the whole Department. In addition to this he will assist the Inspector-General of Forests in the control at present exercised by the Government of India in the preparation of working plans, performing in this matter the functions at present exercised by the Assistant Inspector-General of Forests. In order to render this assistance more effective, and to remove a serious defect in the present system, he will visit the forests in which working plans are being prepared, and will record a note upon the local conditions of the forest for the information of the Inspector-General of Forests. A copy of this note will also be sent through the Conservator to the local Government for information and for any action that they may care to take upon it. (3) An Imperial Forest Zoologist, whose chief duty will be to investigate the damage caused by insects and other pests, and to suggest remedial measures. (4) An Imperial Forest Botanist, who will study the botany of forest plants, diseases of trees, and distribution of species. (5) An Imperial Forest Chemist, who will investigate the chemical properties of soils and of the produce of the forests. (6) An Imperial Forest Economist, who will make a special study of the best methods of rendering forest produce of all kinds available at the smallest cost to consumers, and who will keep in touch with the commerce of India with a view of fostering and meeting the demand for forest products. These officers, in addition to their research work, will each deliver a course of lectures on his special subject at the College, and take part in the training of students, but the educational work will be mainly carried on by Assistant Instructors, who, besides their duties in the class room, will be in personal charge of the students out of lecture hours and during their practical training in the forests. They will be four in number, and will usually be selected from the Provincial Forest Service. One of the Imperial officers, who will ordinarily be a Conservator of Forests, will, in addition to his other duties, hold the post of Principal. The members of the Staff, who will be seconded on their respective lists, will draw the pay, substantive or officiating, to which they are entitled on those lists, together

with the following local allowances: Principal, Rs. 200 per mensem; other Imperial Officers, Rs. 150 per mensem; Assistant Instructors, Rs. 75 per mensem."

[The above Resolution will be hailed with satisfaction, as providing the means of placing Indian Forest Management on a sound and rational footing, based on local investigation. We trust that before long the Home Government will confer a similar benefit on our own Forest Industry.—HON. ED.]

LARCH DISEASE ON *Pinus Laricio* AND *Pinus sylvestris*.

In 1883 I planted up an opening 400 or 500 yards long and about 20 yards wide through a wood about fifty years old. The glade had been left for landscape effect; but, as it gave upon the open sea, the gales of 1881-82 had wrought great mischief upon the garden at the north end of it, so I determined to plant it up. The soil, I believe, had never been cultivated, at all events not during the previous eighty years. The trees planted were larch, Scots and Corsican pines, and beech, with a few *Pinus insignis* and *Cupressus macrocarpa* next the garden end. All grew rapidly, but the larch became so badly affected with *Perisporidium* that they were all cut out in 1900. During the present season I detected the larch disease on two of the Corsican pines (one of these trees was in a suppressed condition). I sent a section of the stem to Kew, where the fungus was verified. I may mention, in passing, that the *Pinus insignis* has far outstripped all the other trees in this plot, one of them having attained the height of 62 feet in twenty-two years.

In another plantation of twenty years' growth, where some of the larch have been affected, I have found a Scots pine bearing the disease. This is the first instance recorded, so far as I know, of the growth of that fungus upon this species of pine.[1]

Thuja gigantea.—Anybody who has visited Mr Younger's fine woodland at Benmore, in Argyleshire, will be inclined to ratify the forecast made to me more than thirty years ago by Mr Peter Lawson, that *Thuja gigantea* (*Lobbii*, as it was then called) was to be the tree of the future in British woodlands. At Benmore may be seen about 2000 acres, planted from twenty-eight to

[1] The disease has been previously observed on Scots pine.

thirty-five years ago almost exclusively with Douglas fir and *Thuja*, which have grown since under forest conditions, and rival each other in height and girth. Nevertheless, some care should be exercised in planting the *Thuja*, for it is liable to injury from frost when in a young state, especially on low ground. My own experience with it may be of service to others.

In the spring of 1901 I sowed fifteen shillings' worth of seed of *Thuja gigantea* obtained from Johannes Rafn of Copenhagen, which produced between 50,000 and 60,000 plants. After once transplanting, these were fit to put out in the spring of 1904, being then 12 to 15 inches high. They were planted in various places, among other, 7 acres of flat ground, whence a crop of spruce had been removed, were planted solid with them. They grew at a great pace during the summer, but in the spring of 1905 came a severe late frost, which killed half of them outright, and sorely crippled the rest. Along the south side of this plot is a wood about fifty years old on rising ground, screening a strip of land from the southern sun. In this strip the *Thujas* hardly suffered at all; here, and elsewhere, the shelter of older trees saved them, and they are now 3, 4, and even 6 feet high. The lesson from this is the same which Mr Munro Ferguson has exemplified at Novar, namely, that this valuable tree should be used for underplanting older wood.

Is *Rhododendron barbatum* Insectivorous?

The buds of *Rhododendron barbatum*, like those of the horse-chestnut, are covered during summer and autumn with an exceedingly clammy, green varnish, which hardens in winter into a brown coat. Innumerable flies, attracted by the glistening buds, settle upon them, and pay the penalty of death. The characteristic bristles on the petioles of the leaves, whence the plant takes its specific name, assist in the entanglement of the larger-winged insects which otherwise might be strong enough to escape. Is this indiscriminate slaughter without purpose, or does the plant derive nutriment from its mixed bag of victims?

Why is this splendid rhododendron so seldom grown? It is as hardy as *R. ponticum*, though its blossoms, of matchless scarlet, are apt to be destroyed by the frosts of March. This danger may be mitigated if the plant is grown in the partial shade of an open wood.

Herbert Maxwell.

Monreith, *October* 1906.

Combating Cockchafer Attack in the Nursery.

The following method I have found very effective in checking the spread of this pest in our nursery here.

Whether the attack be in the seed-beds or in the transplant lines, I dig a trench, from 6 inches to 1 foot wide, and about 18 inches deep, round the affected area, and this I either fill with a mixture of soot and kainit (a larger proportion of the former being used), and a little soil, or I leave it open and place about an inch of soot in the bottom. In the former case the grubs are unable to pass through the soot and kainit mixture; in the latter they fall into the ditch, and being unable to extricate themselves from the soot, can be collected by hand, which should be done every morning. As soon as I can get the nursery crop removed, I, if possible, sow the infested ground with a green crop, such as turnips or peas (the latter I dig down when in flower for manure), or plant it with potatoes, using a heavy dressing of soot and kainit. This mixture seems to destroy the grubs, as I have rarely seen any after it was applied, and by adopting this procedure I am able to have the ground again ready for seed-beds or seedlings in the autumn.

Wm. Mackenzie,
Forester, Novar.

Systematic Destruction of Squirrels.

The immense damage done by squirrels to Scots pine woods in the north of Scotland induced the owners of such woods, some four years ago, to consider how best they could get rid of these destructive animals. When it is kept in view that the value of Scots pine timber is probably as much reduced by squirrel damage as the cost of planting is increased through damage by rabbits, it will be seen how necessary it is to put a stop to the havoc wrought by the squirrel.

Immunity from squirrel damage is impossible on any one estate unless practically all the woodland owners in the district

unite upon an effective plan of concerted action. On most estates efforts are made to keep down squirrels. Sometimes as much as 4d. a tail is paid for them, but in no case is immunity secured. The keeping down of squirrels by gamekeepers depends more upon the keeper than upon the reward, as it is frequently observed that squirrels will abound in woods patrolled by keepers, excepting perhaps where there is one keeper who takes an exceptional interest in the work, or where there is one who has a trained squirrel dog. Dogs are necessary if squirrels are to be put down, and the best dog is one trained to hunt squirrels only. The need for concerted action arises from the fact that one wood occupied by squirrels will infest a whole country-side. These facts were accepted as a basis for action by the larger number of woodland owners in Ross-shire, and in the late summer of 1902 a meeting of the principal proprietors there was held and a Squirrel Club formed. The object of the Club was to protect woods from the ravages of squirrels, the inadequacy of individual effort to cope with the extraordinary damage caused by them being the reason for its formation. The Club was originally confined to owners of woodlands in Ross and Cromarty, but now its operations extend also to the portion of Inverness-shire north of the Caledonian Canal. The rules adopted by the Club were that during the months of October and November the woodlands of the members of the Club were to be examined by its inspector, who was to report to the secretary, through whom all correspondence would pass. Copies of the inspector's report would be furnished to members. A list of Club squirrel-killers who would be open for engagement in the months of November and May was to be kept by the secretary. Killers of reliable character were to receive a sum of £3 per annum for the keep of a trained squirrel dog, and 21s. per week when engaged by the Club or its members, half of this wage being payable by the Club, and half by the member whose woods were reported by the inspector to contain an excessive number of squirrels.

The subscription for the first year was fixed at £1, with an additional further subscription of one penny per acre for each acre over 200. The result of the first year's working was presented in February 1904, when the subscription was reduced by one-half, members whose woods did not exceed 200 acres

subscribing 10s. per annum, and those whose woods exceeded 200 acres subscribing at the rate of one halfpenny per acre for every acre above 200. In the first year the woodland area covered by the Club's operations was 38,292 acres, the subscription amounting to £167, 19s. 5d. The number of squirrels killed was 4727, and the bonuses paid upon squirrels' tails was £77, 6s. 8d. In the next year (1904) the area of the Club's operations was increased by 600 acres, the subscription was £85, 6s. 5d., the number of squirrels killed was 3988, and the bonuses paid amounted to £66, 9s. 4d. Last year the Club's operations extended over 46,985 acres, including a portion of Inverness-shire; the subscription was again reduced, the amount collected was £51, 14s. 3d., the number of squirrels killed was 3431, and the bonuses paid amounted to £56, 18s. 4d.

Continuous systematic effort has apparently had the effect of reducing the number of squirrels within the area of the Club's operations, and practically all the woods in the district have been patrolled. The foci where trouble might be looked for have been controlled, and the numbers have been kept down. One or two instances, selected from estates working under the Club's arrangements, may be given as fair instances of the effect of the work. On one estate containing 4000 acres of woods, the numbers for the last three years were 178, 134, 107; on another estate of 4000 acres, the numbers for the same period were 515, 375, 144; on another of 1220 they were 272, 87, 183; on another of 1000 they were 57, 66, 46; on another of 400 they were 120, 186, 71; on another of 2000 they were 231, 259, 188; on another of 3370 they were 152, 92, 98; and on another of 6920 they were 1208, 1309, 671.

If the country were divided into districts, and combined action, similar to what has been taken in Ross-shire, adopted in each, the prospects of the destruction of squirrels would be greatly improved, and an addition would be made to the value of Scots pine woods throughout the country—a thing to be hoped for, but hardly likely to be realised under present conditions.

A. FRASER,
Inverness.

Spread of Fungus Diseases by means of Hybernating Mycelium.

The *Journal of the Board of Agriculture* for August 1906 contains an article entitled "The Spread of Fungus Diseases by means of Hybernating Mycelium." The gist of the article is that certain diseases may be communicated from the parent plant to the seedling through hybernating mycelium, which takes up its abode in the seed. Attention is also called to the fact that disease may be spread in vegetative propagation, such as by tubers and bulbs. The main interest in the article lies in the fact that, in certain plants, disease has been found to pass from one generation to another by infected seed, and entirely without the intervention of spores. The phenomenon appears as yet to have been observed only in the case of grasses, but whether or not this method of disease propagation holds good among trees is a matter for future investigation. A. W. B.

"Slime-flux" on Beech Trees.[1]

The disease known as "Slime-flux" is due to the activity of certain very minute yeast-like organisms, which set up fermentation and subsequent dissolution of the elements of the wood and bark. This results in the formation of weeping wounds. If such wounded parts are removed at an early stage, the cavity treated with a fungicide, and afterwards carefully closed, but little injury follows. On the other hand, if the disease is allowed to run its course, the wood becomes sodden with water, and the tree eventually dies.

Botanical Survey of Scotland.

The *Scottish Geographical Magazine* for May 1906 contains an article by M. Hardie, D.Sc., entitled "Botanical Survey of Scotland." The scientific and practical importance of such a Survey is first emphasised by the author, who then proceeds to outline the plan he has adopted to lay the foundations upon which a future detailed Botanical Survey may be built up.

[1] Reproduced from the *Journal of the Board of Agriculture* for June 1906, by permission of the Controller of His Majesty's Stationery Office.

He divides the North of Scotland into ten phyto-geographical districts, which are indicated on a map accompanying the article. The various topographical features of these districts are described, together with the characteristic flora of each. The whole question is of the greatest interest from a botanical point of view, but incidentally the author makes reference to matters which are also of interest to the forester.

Naturally, the character of the forest flora will vary in the different districts according to the factors of the locality. We take the following quotation from page 233:—"A more abundant rainfall on the Atlantic section has so far accelerated the modelling of the West Highlands as to reduce the original upheaved peneplain to narrow ridges and peaks, while the Grampians are left at the stage of large blocks, with but a rude carving as yet. The same agency is responsible for a well-marked and well-known difference in the vegetation. A constantly moist, mild, and cloudy atmosphere, with a fairly regular distribution of rainfall all the year round, and an abundant supply of ground water, form ideal conditions for the development of pasture. Indeed, in the west we have to deal with an essentially pastoral landscape. According to local circumstances of gradient and drainage, of nature of soil and subsoil, of altitude and exposure, the numerous modalities of a complete series of pastures are displayed before us. They range from peat-bogs and wet moors, on bottom and terrace lands, to the dry grass moors and the alpine deserts on the steeper and upper slopes and summits. The whole of this section is, to a surprising degree, bare of forests, not from any natural cause, but through the agency of man. That this work of destruction has been made easier by the fact that in the sub-alpine zone a species of forest tree, thoroughly adapted to the climate, was lacking, is, however, very likely. For the excess of rainfall and wind is not favourable to the Scots pine, the only native timber of importance for this zone, or to the larch, which has much the same ecologic requirements. Norway spruce, silver fir, and the Douglas fir would, under proper management, be best suited to these western hills. In the lower parts, mixed deciduous forests are quite at home, although there remain but insignificant vestiges of their former splendour. Cereal cultivation is similarly discouraged by the excessive rainfall, and finds but little available ground along the raised

beaches and on bottom lands. Thus, setting apart the question of forests, the West Highlands are fit for little else than pastoral industry."

In contradistinction to the Western Highlands, the author points out that on the east the drier and clearer atmosphere and the more extreme climate give rise to quite a different vegetation. He says of the Eastern Highlands:—"Their vegetation is essentially one of heather and dry grass moors on the slopes, with extensive peat caps on the plateaux and terraces under 2500 feet, and alpine deserts on the broad higher summits. Here, indeed, are found ideal conditions for Scots pine and larch in the sub-alpine zone, and for mixed oak forests up to 900 feet. After the wholesale disforestation, heather and peat soon got the better of the intended pasture, and ever since ling-burning has extended their power and limits."

Speaking of the North-west Highlands, Dr Hardie mentions that the West Sutherland district, running S.S.W. to Ben More, Assynt, has a high rainfall, but that the strength of the north and west gales would probably prevent the existence of forests.

In summarising results on page 237, he points out that "the upper forest limit is determined entirely by wind. It is higher in the east than in the west, at the eastern than at the western exposure, in the south than in the north. Fairly constant at an altitude of from 1800 to 1900 feet in the middle Highlands, it rapidly goes down to from 1400 to 1500 feet on the scattered and exposed mountains of Sutherland, eventually reaching a much lower level on the western slopes of the extreme north-west, which increases in width from south to north and from east to west. It is followed upwards by a pseudo-alpine belt of a few hundred feet in height. Whether this zone could not be partially reclaimed in course of time by modern scientific forestry is yet an open question."

To conclude, on page 238 a fact well known to foresters is mentioned, namely, that "bad management of a pine forest may result in a more or less permanent deterioration of the soil, and the substitution of heather or other waste moors for pine." Farther on the author says, "We may well question, for instance, whether, by reason of too early a separation of Scotland from Scandinavia, the sub-alpine zone of the Western Highlands has had the advantage of ecologically quite suitable forest-trees and associates, like the Norway spruce; or, again, whether there

was not room in the lowlands for the beech and associates whose migration from the south may have been stopped by natural barriers. These points, however, important though they may be in practical forestry, will not, in any way, affect the general value of a map of the natural primitive or potential vegetation."

The article is worth the consideration of those who wish to pursue this subject further. A. W. B.

History of the Scottish Peat Mosses.

The same magazine contains an extremely well-considered and written paper by Mr Francis J. Lewis, F.L.S., on "The History of the Scottish Peat Mosses, and their Relation to the Glacial Period." Very little attention has hitherto in this country been paid to this important subject, although there lies buried in these peat-bogs a vast store of material which, if only brought to light and studied in the proper way, as Mr Lewis has done, will yield a vast store of information of first-rate importance.

In the present paper the author gives a general account of an investigation in which he has been engaged, on the peat deposits in the Scottish southern uplands. Among the numerous new facts ascertained, there are many which are of special interest to foresters, since the history and vicissitudes of the forests which have from time to time occupied the ground are very clearly shown from the records in the peat. To begin with, the author mentions that the peat deposits reach their greatest development in high-lying situations, and that at the present day, on account of insufficient moisture favourable to peat growth, the hill-top, hill-side, and upland valley peat is generally in a state of rapid denudation, and, indeed, has already been completely removed from large areas by incessant rain-washing. In such deposits, which are channelled and furrowed often to a depth of 12 or 15 feet, certain well-defined layers containing tree roots and stems are seen, which indicate the existence of a former forest. To quote the author's own words—"Sometimes one, more frequently two, and occasionally three such forest layers can be recognised, separated by thick beds of peat, quite free from any traces of trees. These forest-remains are frequently present in the peat in districts where no

trees will grow at the present day: to take but two instances, forest-remains are abundant in the peat of the now almost treeless Outer Hebrides, and on the summits of the Grampians, at more than 3000 feet above sea-level. The great thickness of many of our peat deposits (sometimes reaching 30 to 50 feet), the known slow rate of growth of peat, and the frequent presence of two forest zones, is evidence that the conditions have changed considerably since the mosses began to form, and a closer examination has shown that large areas of peat in Britain date back to the later phases of the Glacial period."

Mr Lewis shows, in the course of his paper, that in the upper forest zone, which may be traced in many districts in the north and south of Scotland, *Pinus sylvestris* was the dominant tree, particularly in the Highlands, while in Tweedsmuir and other parts of the southern uplands the prevailing species was birch. On page 249 he states that at one period occurred a widespread growth of *Pinus sylvestris*, of very large size, between 2000 and 3000 feet, in the Highlands. This was followed by a relapse to wet, moorland conditions, which prevail to the present day. Accompanying the article are a very interesting series of illustrative photographs, also a diagram showing the succession of plant-remains in various peat deposits. A. W. B.

Remarkable Conifers in Great Britain.

There are no doubt many very large and remarkable specimens of conifers throughout Great Britain and Ireland, which were not reported to the Conifer Conference of 1891, or to the Board of Agriculture when its list was prepared in 1903. As a contribution towards collecting interesting details of this kind, I may instance the fine *Abies grandis* at Madresfield Court, Malvern, Worcestershire, the seat of Earl Beauchamp. Measured on 7th September 1906, it had a height of 114 feet and a girth of 8 ft. 4 ins. at breast-height. It is probably one of the tallest trees in the United Kingdom.

At the same place there is also a very fine avenue of *Abies nobilis* var. *glauca*, now about sixty years old, but, unfortunately, badly attacked by *Chermes* on the twigs. J. N.

The Value of Willow Timber.

In the columns of the timber trade journals particulars have been given of some extraordinarily high prices which have recently been obtained for willow timber suitable for cricket bat-making. As is well known, there is no other wood which, for lightness, toughness, and resilience, can approach willow for this purpose; and for the best bats the white, or Huntingdon, willow (*Salix alba*) is that which is most prized, the timber of the crack and Bedford willows (*S. fragilis* and *S. Russelliana*) being what is principally used for inferior bats. These prices ranged from 5s. to 10s. 6d. per cubic foot, and in one instance, on the property of Sir Walter Gilbey, at Bishop Stortford, 11s. 6d. was obtained, a figure which eclipses many of those given for fancy foreign hardwoods, and which is at least double what is generally obtained for the most valuable of our British hardwoods, excepting perhaps an occasional large walnut. But to fetch prices like these, the timber must be clean and fast-grown, and it must not be more than about thirty years old. Slow-grown timber, rough timber such as is grown in hedge-rows, or that of old pollarded or defective trees, is quite useless for the purpose, the fibre of the wood being much too hard and brittle. The best timber for the purpose, too, can be grown on land which is, as a rule, of little value agriculturally,—that is, land which is too moist for grain and root crops, and which it might be difficult to drain sufficiently in order to make it pay under these, and which otherwise might be mere waste. A. D. R.

A New Timber.

To the long list of timbers which we import, yet another has to be added. This is camphor-wood (*Cinnamomum Camphora*, Nees), which is now, for the first time, being brought in quantity from Formosa. On account of its excellent sanitary properties, the wood is said to be especially valuable for constructive work, such as flooring, wainscoting, and so forth, in hospitals, etc.

A. D. R.

Creosoted Timber.

In a paper on "Timber as Used in Engineering Structures," which was read before the Newcastle-on-Tyne Association of Students of the Institution of Civil Engineers, Mr J. R. Baterden, Assoc.M.Inst.C.E., states that creosoted timber withstands the teredo and other sea-worms indefinitely, where even greenheart has failed. He is only able to quote one instance of a creosoted pile being attacked, and in this case workmen had cut through the creosoted shell, and thus given the worm access to the interior. Even here, however, the damage done was confined to the unprotected heart. In the Gulf of Mexico, he states, creosoted timber is untouched after sixteen years, whilst the same class of timber used untreated is, in similar conditions, useless at the end of two years. He quotes Mr Preece as stating that in telegraph work he had never in the course of thirty years' experience seen a properly creosoted pole show the slightest sign of decay. The Burnettised poles fixed in 1844 on the London and Southampton and Gosport line, he alleged, had all failed within twenty-seven years; whilst a line of creosoted poles erected between Fareham and Portsmouth in 1848 were as sound when taken up in 1883 as when first put down. The objections to creosoting, he says, are two in number—viz., the liability to fire, and the dirt inseparable from the process.—*The Timber Trades Journal.*

Wood Preservation by Electrolysis.

A new method of applying a preservative to railway ties and timber is described in *L'Industrie Electrique* of Paris. The process consists of the artificial metallisation of the pores of wood, the metal being deposited electrolytically. In brief, the method requires first the application of a solution of some salt—sulphate of copper, for example—by placing the wood immersed in the solution in a closed chamber and subjecting it to pressure. The wood is thus thoroughly impregnated with the solution. It is then taken out and piled up in layers in a concrete reservoir. The first layer of timber is immersed in the same copper sulphate solution, and also rests on a layer of jute or other fibrous material,

which is supported by an electrode made of woven strands of copper. Similar electrodes are placed between each layer of timbers as they are piled up to the desired height. Alternate electrodes are then connected to the opposite poles of an alternating current supply, and the current is allowed to pass. The action is said to decompose the solution and set free metallic copper in the pores of the wood. Besides the preservative action in thus closing the pores, it is said that a certain amount of copper sulphate is permanently retained in the pores, giving an additional preservative effect.—*The Timber News and Sawmill Engineer.*

A "Big Tree's" Centuries of Life.

The following is from a paper sent by Mr Fred Sweetland, Arizona, September 1906.

A remarkable recuperative power following an injury was found after examination of the Sequoias of the Converse Basin. The effects of certain tremendous forest fires occurring centuries ago are registered in the trunks of these trees, and the record is completely concealed by subsequent healthy growth. Among a number of similar cases, the most instructive record of these ancient forest fires was observed in a tree of moderate size —about 15 feet in diameter, measured at 5 feet from the ground. It was 270 feet in height, and 2171 years old. The tree when felled had an enormous surface burn on one side, 30 feet in height, and occupying 18 feet of its circumference; this was found to have been due to a fire occurring A.D. 1797. The tree, when cut in 1900, had already occupied itself for 103 years in its efforts to repair this injury, its method being [illegible]growth of new tissue from the margin of the great black [illegible]und. When the tree was cut the records of four fires were [illegible]ealed. The history of the tree was as follows:—

[illegible]n 271 B.C. it began its existence. In the first year of the [illegible]istian era it was about 4 feet in diameter above the base.

[illegible]n 245 A.D., at 516 years of age, occurred a burning on trunk 3 feet wide. One hundred and five years were [illegible]pied in covering this wound with new tissue. For 1196 [illegible]s no further injuries were registered.

In 1441 A.D., at 1712 years of age, the tree was burned a second time in two long grooves, 1 and 2 feet wide respectively. Each had its own system of repair. One hundred and thirty-nine years of growth followed, including the time occupied by covering the wounds.

In 1580 A.D., at 1851 years of age, occurred another fire, causing a burn on the trunk 2 feet wide, which took fifty-six years to cover with new tissue. Two hundred and seventeen years of growth followed this burn.

In 1797 A.D., when the tree was 2068 years old, a tremendous fire attacked it, burning the great scar 18 feet wide. One hundred and three years, between 1797 and 1900, had enabled the tree to reduce the exposed area of the burn to about 14 feet in width.

It is to be noted that in each of the three older burns there was a thin cavity occupied by the charcoal of the burned surface, but the wounds were finally fully covered and the new tissue overlaying them was full.

W. B. HAVELOCK,
Brocklesby Park, Lincs.

FORESTS IN WESTERN AUSTRALIA.

A report just issued by the Premier of Western Australia states that the total wooded area of the colony is estimated at 98,000,000 acres, and the extent of merchantable timber has been reckoned to be, approximataly, as follows:—Jarrah mainly (with blackbutt and red gum interspersed), 8,000,000 acres; Karri, 1,200,000 acres; Tuart, 200,000 acres; Wandoo (white gum) and allied timbers, 7,000,000 acres; York gum, yate, sandal-wood, and jam-wood, 4,000,000 acres—total, 20,400,000 acres. This represents a forest area of merchantable timber four times greater than the whole area of Wales. The total value of timber exported from Western Australia for the ten years ended 1904 was £4,800,000.—*The Timber News and Sawmill Engineer.*

FORESTRY APPOINTMENTS.

Professor Somerville.

The most important appointment of the year is that of Dr Somerville, one of the Assistant Secretaries to the Board of Agriculture, to the Sibthorpian Chair of Rural Economy in the University of Oxford. Professor Somerville commenced his career as an agriculturist, and he enjoys the distinction of being the first student to obtain the then recently instituted degree of B.Sc. in agriculture at the University of Edinburgh. Next turning his attention to forestry, he repaired to the famous Forest School of Munich, where he graduated D.Œc., and on his return to Scotland he started a course of lectures on forestry in the University of Edinburgh. Soon thereafter he was appointed Professor of Agriculture and Forestry in the Durham College of Science at Newcastle-on-Tyne; subsequently he was transferred to the Chair of Agriculture in Cambridge University; next he went to the Board of Agriculture as one of its Assistant Secretaries; and now he has been selected to fill the important post above alluded to. All members of the Society who know Professor Somerville and the good work he has done for forestry will wish him every success in his new post.

Mr A. C. Forbes.

Mr Arthur C. Forbes, Lecturer in Forestry at the Armstrong College, Newcastle-on-Tyne, has been appointed Forestry Expert under the Department of Agriculture and Technical Instruction for Ireland. As a practical forester, Mr Forbes has had an extensive experience, he having held the post of head forester for a number of years on the Wiltshire estates of the Marquis of Lansdowne, and prior to his appointment to Newcastle he held a similar position on the estates of the Marquis of Bath.

He attended Dr Somerville's first course of lectures at Edinburgh University, taking first place in the prize list, and subsequently he spent some time in Germany. He is a well-known writer on forestry, and recently he published a work of considerable merit entitled *English Estate Forestry*. In appointing Mr Forbes to this important post, all will agree that the Irish Government have made a wise selection.

Mr J. F. Annand.

Mr John F. Annand, overseer on the Peeebleshire estates of Sir Duncan Hay, Bart., has been appointed to succeed Mr Forbes as Lecturer in Forestry at the Armstrong College, Newcastle-on-Tyne. Like Mr Forbes, Mr Annand is a practical forester. In 1892 he entered the Royal Botanic Garden, Edinburgh, for the purpose of passing through the course of instruction which had been instituted there for practical foresters and gardeners, and three years later he, along with one of his colleagues, Mr Wm. Davidson, now head forester on the Margam estates in South Wales, obtained the diploma in forestry of the Highland and Agricultural Society. The best wishes of all will follow Mr Annand into his new sphere, where we are confident he will prove a worthy successor to Mr Forbes.

A. D. R.

REVIEWS AND NOTICES OF BOOKS.

Trees: A Handbook of Forest Botany for the Woodlands and the Laboratory. By H. MARSHALL WARD, Sc.D., F.R.S., etc. Vol. III., "Flowers and Inflorescences." Cambridge University Press, 1905. Price 4s. 6d. net.

When this work was commenced, it was the intention of the author that it should run into six volumes, but alas! ere more than half the series has been completed, he has passed away.

Professor Marshall Ward died at Torquay in August 1906, at the comparatively early age of 53. At the time of his death he occupied the chair of Botany in Cambridge University, in which he succeeded the late Professor Babington. He was one of the most distinguished of our English botanists, and he was exceptional among his confrères in that he devoted a considerable part of his time and talent to forest-botany. His best known works relating to forestry are *Timber and Some of its Diseases* and *The Oak*. He also edited the last edition of Laslett's *Timber and Timber Trees;* revised and edited Dr Somerville's translation of Professor Hartig's classic *Lehrbuch der Pflanzenkrankheiten;* contributed the chapter on the botanical characters of forest trees to the second volume of Dr Schlich's *Manual of Forestry;* and at the time of his death he was engaged on the work under notice.

In this, the third, volume of the series, the author deals with "Flowers and Inflorescences." The plan followed is similar to that adopted in the preceding volumes; that is, the book is divided into two parts—"General" and "Special." In the "General" part the structure of the flower and the inflorescence is dealt with, and the various types of the latter are discussed (a by no means easy subject for the novice in forest or any other kind of botany to grapple with), and this part of the book bears evidence of the same painstaking and careful work which

characterised the "General" parts of the preceding volumes. But the "Special" part is not so satisfactory. In fact, in all three volumes there is in these "Special" parts regrettable confusion in the descriptions of some of the more important species, and unfortunate omissions of some of the others; and should it be the intention to carry Professor Ward's work to a conclusion (and it is hoped that this will be done), it may not be out of place here to draw attention to a few of them.

The greatest confusion, perhaps, occurs in the genus *Ulmus* (admittedly a very difficult one). In the case of the Scotch and English elms the synonymy seems to have got inextricably mixed up, and to the latter species an erroneous description has been applied. In the first volume the author states an undoubted truth when he says that "there is still considerable difficulty about the various sub-species or varieties of elms"; but he must have been under some misapprehension as to the distinctions between the Scotch and English species when he described the twigs and buds of the former as being "stiffly hairy," and those of the latter as being "practically smooth" (vol. i. p. 184). In the typical *Ulmus campestris*, the twigs, though thinner, are quite as hairy as they are in the Scotch species (*U. montana*). Possibly the author has confounded two closely allied species, *U. campestris* and *U. glabra*, and the description of the former may have been drawn up from material derived from the latter. In such genera as *Tilia*, *Populus*, *Picea*, *Pinus*, and several others, too, matters are not quite satisfactory in this respect. Some of the more important species, from a forestry point of view, which have been omitted from the work are the white alder (*Alnus incana*), the Menzies spruce (*Picea sitchensis*), the Japanese larch (*Larix leptolepis*), the Corsican (as distinct from the Austrian) pine (*Pinus Laricio*), the Lawson Cypress (*Cupressus Lawsoniana*), and the Prince Albert fir (*Tsuga Mertensiana*), while several of minor importance might be mentioned. Again, many species, such as some of the rarer Alpine willows (which in this country occur at altitudes considerably above the limit of forest growth), the vine, the Virginian creeper, *Ficus carica*, and many others, which seldom or never occur in woodlands, might have been omitted from the work.

But while the opportunity is here taken to point out these blemishes in what is undoubtedly the most important work of the kind in the English language, it is done in no carping spirit.

No one recognises more fully than does the author of this review the difficulties which have to be faced in a work of this sort, more especially in genera such as *Ulmus*, *Populus*, and *Salix*. Professor Ward set himself a difficult as well as a big task, and if he has fallen short of the ideal which he fixed for himself, the shortage must not be measured by itself; it must be taken with the whole, and by contrast it sinks into an insignificantly small proportion of it. All interested in this important branch of botany will join in regret that its talented author was not spared to complete his work. *Ars longa, vita brevis.*

A. D. R.

Departmental Notes on Insects that affect Forestry in India. Part III. By E. B. STEBBING, Forest Entomologist to the Government of India.

This is a continuation of the notes that appeared in 1902 and 1903.

The present volume, extending to over one hundred pages, is a record of excellent observational work on forest insects in India. Thirty-two different species of trees are noticed with insects infesting them. Some of the insects described are new to science. The notes on life-history and habits cannot fail to aid greatly those concerned in forestry in India, the more so as the descriptions—unless where technical terms are absolutely necessary—are in easily understood non-technical language.

An additional feature of the volume is an excellent set of eight full-page plates illustrative of insects themselves and of their damage.

R. S. M.

SOME RECENT BOOKS ON FORESTRY.

Schlich's (W.) *Manual of Forestry*. Vol. I., "Forest Policy in the British Empire," 3rd ed., revised and enlarged. 6s. net.

American Works.

	Dollars.
Schenck's *Forest Utilisation*, . . .	5.00
Joy's *Forestry Problems in United States*, .	.25
Graves' *Forest Mensuration*, . . .	4.00

HON. ED.

OBITUARY NOTICE.

William Mackinnon.

With much regret we have to record the death of Mr Wm. Mackinnon, which occurred on the 24th of October 1906, at his residence at Murrayfield, after a protracted illness.

An Aberdeenshire man, Mr Mackinnon, after serving his apprenticeship with the firm of James Cocker & Sons, Aberdeen, migrated southwards, and some twenty years ago became manager of the nursery and seed-trade firm of John Downie, Edinburgh, an appointment which he held at the time of his death. During his connection with Mr Downie's firm he became known to a wide circle of people, and amongst horticulturists and arboriculturists alike, his simple, kindly nature won him many friends. At the time of his death Mr Mackinnon was a member of this Society's Council (on which he had previously served for several terms), and as a member of the Excursion Committee he was one of the most frequent attendants at the annual outings. He was also at the time of his death a member of Council of the Scottish Horticultural Association, the Honorary Treasurership of which he resigned a year ago; and he was an ex-member of Council of the Royal Caledonian Horticultural Society. In all three societies his memory will long be cherished as one of the most likeable of men.

A. D. R.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING.

PROCEEDINGS IN 1906—*Continued.*

THE GENERAL MEETING.

The General Meeting of the Royal Scottish Arboricultural Society was held in the General Meeting Room in the Highland and Agricultural Society's Showyard at Peebles, on Thursday, 19th July 1906, at 1.30 P.M. W. STEUART FOTHRINGHAM of Murthly, President of the Society, occupied the Chair, and there was a fair attendance of members.

MINUTES.

The Chairman mentioned that the Minutes of last Annual Meeting had already been printed and circulated amongst the Members, and he suggested that they should be held as read and approved of, which was agreed to.

CHAIRMAN'S REMARKS.

In opening his remarks, the CHAIRMAN thanked the Directors of the Highland and Agricultural Society for the use of the room for the meeting, for the encouragement they had always given to this Society, and for the handsome grant they had again made to the Prize Fund in connection with the annual Forestry Exhibition. He also thanked the Exhibition Committee for all the trouble

they had taken in connection with the arrangements for the Exhibition, and especially Mr John F. Annand, the Convener of the Committee, upon whom a very large share of the responsibility had devolved. They had been fortunate this year in being able to arrange for a lecture on each of the four days of the Exhibition. Two of these lectures had already been given, one by Mr Annand, on the opening day, on "The Exhibits," and the other by Mr Munro Ferguson, on the second day, on "The Present Position as regards Instruction in Sylviculture." They were to have Sir John Stirling-Maxwell's address on "Hill Planting" at the end of the business meeting, and Mr A. D. Richardson would lecture on "The Larch Disease Fungus" on the closing day. He thought that the Society was much indebted to these gentlemen for their services, and he begged to move a very hearty vote of thanks to all of them.

The Chairman then referred with satisfaction to the new arrangement by which the *Transactions* were to be issued half-yearly, and congratulated the Editors and the Committee on the punctuality with which the first half-yearly part had been issued.

Aberdeen Branch.

The President reported that, in terms of the regulations passed at last meeting, a requisition, signed by forty-five Members residing in Aberdeen district, had been received and approved by the Council, and that a meeting had been held in Aberdeen on 18th May last, which he and the Secretary had attended, when the Branch was duly constituted, and the following Office-Bearers were elected:—*President*—Mr Alex. M. Gordon of Newton. *Vice-Presidents*—Sidney J. Gammell of Drumtochty; Lieut.-Col. Innes of Learney; Professor Trail, Aberdeen; and Mr William M'Intosh, Fife Estates Office. *Committee*—Mr John Crozier, Durris; Mr John Clark, Haddo; Mr R. B. Greig, Marischal College; Mr John Michie, Balmoral; Mr Alex. Robson, Aberdeen; Mr John Rule, Huntly; Mr John Hart, Mains of Cowie; Mr Thomas Braid, Durris; Mr James Allan, Bucksburn; Mr J. A. Duthie, Aberdeen; Mr Andrew Bell, Forglen; and Mr C. S. France, Aberdeen. *Honorary Secretary and Treasurer*—Mr Robert Scott, Solicitor, 75 Union Street, Aberdeen.

Forestry Exhibition.

The Judges' Awards in connection with the Forestry Exhibition were then intimated in terms of their Report, as follows:—

Report by the Judges on the Forestry Exhibition held within the Highland and Agricultural Society's Show-ground at Peebles from 17th to 20th July 1906. We beg to submit our awards as follows:—

Competition No. I.

For Boards of Scots Pine, Larch, and Norway Spruce.

1st Prize,	£2, 10s.,	Sir Duncan E. Hay, Bart. of Smithfield and Haystoun.
2nd Prize,	£1, 10s.,	The Earl of Mansfield.
3rd Prize,	£1,	Sir Duncan E. Hay, Bart.

Competition No. II.

Specimens of the Timber of any Three Coniferous Timber Trees other than the above.

1st Prize,	£2, 10s.,	The Duke of Buccleuch.
2nd Prize,	£1, 10s.,	W. Steuart Fothringham of Murthly.

Competition No. III.

For Boards of Ash, Oak, and Elm.

1st Prize,	£2, 10s.,	Sir Duncan E. Hay, Bart.
2nd Prize,	£1, 10s.,	The Earl of Mansfield.
3rd Prize,	£1,	Sir Duncan E. Hay, Bart.

Competition No. IV.

Specimens of the Timber of any Three Broad-leaved Timber Trees, other than the above.

1st Prize,	£2, 10s.,	Sir Duncan E. Hay, Bart.
2nd Prize,	£1, 10s.,	The Marquis of Breadalbane.

Competition No. VI.

Gate for Estate or Farm Use, manufactured from Home-grown Timber.

The Earl of Mansfield, . No. 1 Silver Medal.

Competition No. VII.

Full-sized Section of Rustic Fence, made from Larch or other Thinnings.

Alex. Pollock, Tarbolton, . No. 2 Silver Medal.
Sir Duncan E. Hay, Bart., Bronze Medal.

Competition No. XII.

Examples showing the Best Methods of Utilising Small Wood.

The Earl of Mansfield, . No. 2 Silver Medal.
John Smith, Peebles, . No. 2 Silver Medal.
Alex. Pollock, Tarbolton, . Bronze Medal.

Competition No. XVI.

Any approved Article either wholly or mainly made of Wood.

Wm. Sinton & Sons, Jedburgh. Tree Plant Tub, and Vase for shrub or flowers. No. 1 Silver Medal.

Jas. Gillespie, Blairmore, Braco. A Model Gate. No. 2 Silver Medal.

Alex. Pollock, Tarbolton. Fancy Rustic Seat. No. 2 Silver Medal.

Articles for Exhibition only.

In compliance with the suggestion of the Committee, that in the event of an Exhibit of special merit being brought forward, the Judges might recommend one of the Society's Medals or other Award, we beg to recommend that the following Awards be made, viz.:—

To Jas. A. Weale, Timber Merchant, Liverpool, for his exhibit of 800 Photo-micrographs of British and Foreign Timbers (transverse sections), at a magnification of 10 diameters—the Society's Gold Medal.

To W. Steuart Fothringham of Murthly, for his exhibit of a Model Water-Gate for crossing a stream, showing the convenience of putting on or removing the gate without going into the water—a No. 1 Silver Medal.

To Dr Borthwick, Hon. Cryptogamist to the Society, for Herbarium Specimens of Forest Trees, showing branch, flower, and fruit of various species—a No. 1 Silver Medal.

To A. T. Gillanders, F.E.S., Park Cottage, Alnwick, for his collection of Insects Injurious to Forest Trees—a No. 1 Silver Medal.

To Sir Duncan E. Hay, Bart., for a large collection of Coniferous Trees showing examples of Annual Growths under various conditions, examples of Wood showing Larch Canker and other Diseases, examples of Larch damaged by Squirrels, and specimens of Matured Larch Trees—a No. 1 Silver Medal.

We desire to bring before the notice of the Committee an exhibit in Competition No. I., sent from Ireland by Mr Hodson, agent for the trustees of the late Sir John Arnott, Bart., Bandon, Co. Cork. Owing to the fact that the boards were taken from trees of much less age than the other exhibits, we could not include them in the ordinary prize list, but, considering the excellence of the quality of the timber, and the skilful manner in which the boards were manufactured, we are unanimous in recommending a special award of a No. 2 Silver Medal.

We have pleasure in reporting that the exhibits on this occasion compared favourably with those of former years. In the sawing and handling of manufactured timber there was a noticeable improvement compared with previous Exhibitions. It was, however, disappointing to find that in such a well-wooded district as Peeblesshire so few of the competitions were taken part in by local landowners.

In one instance which occurred in Competition No. I., an exhibit of first-class merit had to be disqualified because of an infringement of the rule directing that each set of three boards must be sawn from a "single root cut." Had this rule been observed, the exhibit would have taken a place in the prize list.

Considering the importance of Competition No. VI.—for a Gate for Estate or Farm Use—it was matter for regret that only one competitor entered. We respectfully suggest that, supplementary to this competition, a prize should be offered for examples of various methods of fencing against farm stock; the cost of material and mode of erection, coupled with efficiency, to be of primary importance. A competition on these lines would, we think, be both attractive and useful for landowners, foresters, and farmers.

Many of the articles sent, for Exhibition only, were of exceptional merit, and, apart from those mentioned in the list of awards, there were others that deserve a word of praise. A most interesting exhibit was forwarded by Mr Allan from

Polkemmet, showing Larch Stobs which had been in use for forty-two years, and which, from their appearance, might be expected to last for a number of years longer. A rather exceptional exhibit of Scots Fir Stobs was sent by the Marquis of Tweeddale, Yester. They had been in the ground for forty years, and were still quite fresh, the points showing no sign of decay. They were cut from trees between thirty and forty years old, peeled and dried, then steeped in tar. Lord Mansfield exhibited some fine Specimen Boards of Home and Exotic Timber, and a collection of Tools used on Scone Estates. F. R. S. Balfour, Esq. of Dawick, and Mr Berry, forester to Lord Minto, Hawick, had each a most interesting and instructive exhibit, and they deserve credit for the trouble they must have had in collecting and bringing together such a varied assortment.

In conclusion, we beg to express our entire satisfaction with the arrangements made by Mr Annand and the other members of the Exhibition Committee, which made the task of judging both easy and pleasant.

GEO. U. MACDONALD.
ADAM SPIERS.
JOHN CROZIER.

The Secretary reported that the Council had unanimously agreed to the Judges' recommendations, and the Report was approved of.

JUDGES' REPORT ON ESSAYS.

The Secretary gave in the Report of the Judges on the following Essays submitted to them, viz.:—

CLASS I.

(1) "The Prospects of Growing Timber for Profit in the United Kingdom."

Award—No. 1 Silver Medal, to DAVID TAIT, Owston Park, Doncaster.

(2) "The Prospects of Growing Timber for Profit in the United Kingdom." By "En Avant."

No Award.

(3) "Fencing for Farm Stock."

Award—Bronze Medal, to THOMAS HALL, Moore Abbey, Monasterevan, Co. Kildare.

(4) "Thirty-eight Years' Management of Woods." By "Quod verum Tutum."

No Award.

(5) "The Best Method of Preventing Damage by the Pine Weevil (*Hylobius abietis*)."

Award—No. 2 Silver Medal, to EWAN S. GRANT, Edensor, Bakewell, Derbyshire.

(6) "*Agaricus Melleus*—the Honey Agaric."

Award—No. 2 Silver Medal, to EWAN S. GRANT.

CLASS II.

(1) "The Propagation of Forest Trees and Shrubs based on Personal Experience."

Award—No. 2 Silver Medal, to DAVID LUMSDEN, Assistant Forester, Murthly.

(2) "Fencing in Connection with Forestry."

Award—Bronze Medal, to WM. HENRY WHELLINS, Assistant Forester, Raith.

The Report was approved of.

ELECTION OF A TRUSTEE.

On the motion of the PRESIDENT, Sir JOHN STIRLING-MAXWELL, Bart. of Pollok, was elected a Trustee in place of the late Lord Mansfield.

EXCURSION 1906.

Mr BUCHANAN, Convener of the Committee, laid on the table a printed programme of the ensuing Excursion to Northumberland and Durham, and mentioned that a smaller number of Members than usual had intimated their intention of taking part in it.

EXCURSION 1907.

The PRESIDENT reported that the Council had unanimously agreed to recommend that next year's Excursion should be held in Speyside, Inverness-shire, and Ross-shire. The matter was remitted to the Council with powers.

Proposed Scottish National Exhibition, 1908.

The Secretary said he had nothing further to report meantime regarding this Exhibition, and on his suggestion the matter was remitted to the Council with powers.

Ahlbottn & Co.'s Unpaid Account.

The Secretary mentioned that an account amounting to £2, 10s., due by David Hunter, trading under the name of Ahlbottn & Co., for advertising in the *Transactions*, issued in the beginning of 1904, was still unpaid, although he had made repeated demands for a settlement. He asked that the Society should authorise him to take, in his own name, on behalf of the Society, such legal proceedings as might be necessary to recover payment of the account, and this was unanimously agreed to.

This was all the business, and a vote of thanks to the Chairman closed the proceedings.

TRANSACTIONS

OF THE

L SCOTTISH ARBORICULTURAL SOCIETY.

Address delivered at the Fifty-fourth Annual General Meeting, 5th February 1907.

ENNETH J. MACKENZIE, Bart. of Gairloch, President of the Society.

of the objects of our Society may be described as being—

) An effort to keep before the inhabitants of Scotland, and the Government of the day, the fact that in our opinion the desirability of retaining the population in the country districts can be most easily attained by a thorough development of tree-cultivation, on a systematic scale, on land at present more or less unproductive, much of which is suitable for producing timber; and

) The wish to aid prospective planters, whether for appearance or for profit, with information that has been acquired from the experience and by the practice of our members.

regard to the question of maintaining a rural population, no personal belief that under any circumstances shall we : able to induce those members of the working classes ve settled in our big towns to return permanently to the ' districts. And we cannot in reason expect it. The n a town has conveniences which, to the wife who has : accustomed to them, far outbalance any problematic age of cheaper living and fresher air for the bairns in a ' district. If we men had to do the housework, I put it that we should not only hesitate, but, in almost all cases, ely refuse to leave a house with gas and water laid on, where a paraffin lamp has to be cleaned, filled and lit, which water has to be carried some distance from a well. ey mare is supposed to be the better horse, and while I disposed invariably to concur with this proverb, I think st all admit that, in household matters, the woman has a

right to be most fully considered; and it is for this, as well as other more frequently discussed reasons, that I do not think we can hope to take population back to the land which is now established in the towns.

On the other hand, I do think that a great deal might and should be done to retain the present country population in the country districts, and not only the present population, but their descendants also. This we can only do by the provision of employment on a large scale, and by the provision of proper housing accommodation, together with certain attractions and conveniences. I know that other panaceas are suggested. Are they practical or feasible? Take small holdings,—one of the ideas most largely before the public eye at present. Experience does not lead me to believe that small holdings can be profitably occupied, except in situations most exceptionally favoured by soil, climate, and proximity to markets. Such areas are, unfortunately, limited in our country; and while I should most gladly see them occupied by families of small holders who could make a living, I fear it is useless to expect that any development in this direction on practical business lines can be sufficient to affect the larger question of retaining our present rural population, and possibly of increasing it. Small holdings can indeed only touch the fringe of the curtain that we want to see. Turn to allotments: there has been no demand to speak of for allotments in Scotland up to date, and I don't see how that idea, which I think is really a good one, is to be developed under present circumstances. But if there was that quantity of employment going which a fully developed forestry system all over the country would provide, I think there would be a considerable demand for allotments; and I think a man well housed, with an allotment and constant employment at a fair wage, would think more than twice about drifting off to chance obtaining employment in a town.

Now, gentlemen, I am not bringing this before you in any connection with politics, for politics have no place here, and I am not a politician; but, to my mind, the question of retaining a rural population is one of the most important of the day, of vital interest to every Scotsman, and one which stands on a plane above those many questions which form temporary political shuttlecocks. I fear this question is very difficult to solve by any solution which can be permanently successful, but

I think we should do what we can to consider how the object can be attained, and, if we are satisfied that we are advancing a solution which may last for a century, or even a solution which tends to diminish the evil to any great extent, we should press it with all the strength of our united energy.

My own impression is that, while in the past we have asked the powers that be to establish a school for forestry and an experimental area, we have never pressed home the point that, in a matter of such national importance, the State itself should be *the* one to lend every assistance and encouragement to set going work of the kind I have alluded to. So far as I am aware, the State has never yet done a hand's turn in the direction of encouraging and assisting in the extension of tree-culture in Great Britain, except in so far as its management of Crown Lands goes. In this, its action is equivalent only to that of an individual preserving or advancing his own interests, and it cannot be termed national encouragement.

I shrink from estimating how many acres of land there are at present in our country which have a valuation of from 1s. to 3s. per acre for grazing purposes, and yet which are not too rocky, too steep, or at too high an elevation to prevent their producing a crop of larch worth, at least, £90 an acre in seventy or eighty years. But while I shrink from estimating the quantity of land available, I am prepared to assert and prove that even a small area, such as 20,000 acres of such land, under suitable timber-crop, will maintain a great many more families in comfort than they will as a grazing area. Under timber they will, in course of time, increase the assessable value of the locality, and so benefit the parish, the district, the county and the State from the view of taxable capacity; and they will prove as remunerative to the landowner at the close of the cycle as the annual grazing value *if*, and it is a big *if*, the capital with which to face the initial outlay can be obtained at the same cheap rate, as regards interest and repayment, as capital is already advanced at by the State for several other purposes.

You will observe that I put the onus of making such a scheme "work" upon the landowner and not upon the State. I do this because, owing to windfalls and other unforeseen accidents, there is but a small margin, and also because I am dealing with a matter in which the man who sows cannot expect

to reap, and therefore he has to be the more careful that he lays out capital judiciously. It is true, as a general rule, that the larger your concern the more economical is your management; but this holds good only up to a certain point, and I feel pretty confident that one hundred individuals will manage 100,000 acres of timber-crop, spread all over the country, better and more economically than the State could do. I throw out this suggestion with all deference to your knowledge and experience. If, on considering it, which I trust you and others may be disposed to do, you conclude that it is worthy of advancement, it lies with you, by conversation and suggestion with your whole circle of acquaintances, to give it more prominence.

On the subject of the aiding of prospective planters, I wish to bring two points to your notice. First—the Rabbit. Fully as destructive as the squirrel (as to the method of dealing with which I refer you to our last issue of *Transactions*), this animal has caused much harm and ill-feeling all over Great Britain. But while the squirrel has only his charm and beauty to excuse his existence, there is something else to be said for the rabbit. Reduced to soup, he is much appreciated by many people in cases of age or illness; properly associated with an onion, he may even be said to be popular; and many people enjoy a day's rabbiting. I must say I like him to eat, I like to have him to give away, and I like shooting at him; but, except on these occasions, I never wish to see the little brute again.

At present he is pretty well ubiquitous, and one of the main causes which retards the formation of plantations. That is to say, if it were not for the cost of having to wire-net a new plantation, the same outlay would plant nearly double the ground; and even when you have wire-netted, it is marvellous how one or two will get in, and the damage they can do if not immediately killed off. It is the same with agriculture. It is wonderful how much harm a very few rabbits in a wood bordering on a field of turnips can do when the neeps are just coming through the ground, and again later in the year if hard weather comes on before the crop is pulled. Equally he fouls grass land, so that both sheep and cattle loathe it. In plain words, he is a nuisance to "culturalists" of every kind, and being so easily caught and marketed, is apt to tempt some thoughtless lads and lead them on to a path which frequently ends in worse results than the simple taking of a few rabbits. But for all

his wickedness, he is one of our items of food supply, and therefore we cannot suggest his extermination.

A remedy, or a *via media*, is not easy to suggest, but I think the time has come when some attempt should be made to keep him in control, that is to say, that he should be ruthlessly trapped down all over the country except in particular areas on every property, into which he should be wire-netted or retained in some other manner, *if* the proprietor desires to keep him at all. It seems to me very wrong that one man should want to keep his ground clear of rabbits and find it impossible to do so because his neighbour across the dyke maintains them in quantities entirely uncontrolled. I think that if certain areas were set apart for rabbits, and the killing of rabbits outside all such areas were rendered free, we should very soon have them carefully kept under control, and we should not see much of them outside the reserved areas—at any rate, not enough to cause the need for wire-netting for any cultural defence. I don't know that this idea will smile upon some people, but it is the only solution of the difficulty which has struck me, and if you think it worth considering we might, at some future meeting, hold a discussion on the subject, and so arrive at the general opinion of members, when we might be able, as a Society, to formulate some action to mitigate the evil.

The other idea I want to suggest may be of more interest to that large section of our members which comprises the nurserymen and seedsmen. It is about seeds. We hear a great deal about the germinating qualities and the purity of seeds. These are very important matters in their way, but I venture to think that neither of them in all cases gives us the true value of the seed. What is wanted is seed from parents that will give the most vigorous and strong growing plants, and the point I wish to raise is, do we get seedlings of this type from seed taken from trees that are young, middle-aged, or old? I know that at home we try to collect seed from the largest and oldest trees which are still apparently in full vigour, but I just wonder whether these are the trees that produce seed from which the most vigorous type of young plant will spring? As a matter of fact, in the case of humanity and the animal world, the strongest and most vigorous progeny is obtained by the mating of healthy parents on the young side of middle life. I am sure that information on this subject would be of great interest if it could be given to us.

19. The Value of Waste Land for Afforestation Purposes.[1]

By A. C. FORBES, Armstrong College, Newcastle-upon-Tyne.

The term "waste land" is so vague that it is perhaps advisable to make some attempt to define what is meant by it in this paper to begin with. In the Returns of the Board of Agriculture, we do not find any land returned as "waste," but large areas are represented as consisting of "mountain and heath," and to most of this class the term "waste" is usually applied by rural economists. But, although the definition of such land as waste may be relatively correct, we find, when we come to examine it in detail, that the greater part of it has been, and is still, utilised for several purposes which invest it with a low value, and that absolutely waste land in Great Britain is very limited in extent. The chief uses to which mountain and heath land is put vary slightly with the locality in which it exists, and it is necessary to glance at the distribution of this class of land in various parts of the country to ascertain what these uses are.

As regards England, we find that waste land is chiefly confined to the south-west on the one hand and the northern counties on the other. Cornwall, Devonshire, Somerset, Dorset, Hampshire and Surrey possess the largest share in the former part of the country, typical specimens of which are found in the so-called forests of Exmoor and Dartmoor, the Quantock and Blackdown Hills, the stretches of gravelly heaths in the forests of Windsor, Woolmer, Bere and the New Forest, the commons of Surrey, and smaller areas elsewhere. In the north, the bulk of the waste land lies in the hill ranges which form the Pennine Chain, the Lake District, the Yorkshire moors and the fells of Northumberland along the Scottish Border.

Considered as regards their spontaneous vegetation only, there is little difference between the waste lands in the two parts of the country. Both are covered with such surface growths as heather, bracken, rushes, *Vaccinium*, cotton grass and coarse grasses of low value for grazing purposes. But when soils and situations are examined, several important differences are noted. In the south, waste land is chiefly characterised by very poor,

[1] Read before the Royal Scottish Arboricultural Society, 1st August 1906.

sterile soils, lying at moderate or even low elevations. Such soils are chiefly made up of Tertiary gravels, or such as rest on hard, rocky subsoils which interfere with natural and artificial drainage. In the north, on the other hand, waste land is often associated with fairly good soils which have been formed by the weathering of the rock below, or from glacial drift which overlies it. The natural fertility of such soils, however, is usually incapable of being turned to account owing to the altitude at which they lie, and the slope of the hills of which they form the surface. At altitudes of over 1000 feet, the length of the growing season is too short, and the mean summer temperature too low for cultivated crops to return a fair profit, and since the value of agricultural produce has dropped to such a low point, the tendency of late years has been to lay down, or put out of cultivation, large areas of elevated land which at one time existed as arable land. In all hill districts rough pasture may be seen on land which, a few years back, was growing oats, rye, and other hardy crops; but, under present conditions, such land is not likely to be again broken up, and in many cases it is gradually deteriorating by becoming overgrown with gorse, bracken, or heather, and slowly acquiring the same character as the hill land above or around it which has never been under cultivation.

The uses to which such land is put by the owners or occupiers are not numerous. In the south it is usually entirely given up to the grazing of a few store cattle, and the breeding of sheep, donkeys, and ponies. Exmoor is popularly supposed to serve as a range and harbourage for red-deer, but, as a matter of fact, these animals live chiefly in the woods which surround or are interspersed with the moorland. Grouse do not exist, and rabbits are about the only creatures which afford sport in any numbers. So far as agriculture is concerned, these waste lands may be considered practically worthless, the poverty of the soil checking natural herbage, and prohibiting any attempt at manuring or draining where a return is expected. One striking feature of many of these heathy wastes in the south is the rapidity with which they are becoming covered in places by a natural growth of Scots pines and birch, and if not interfered with or destroyed by fire, the afforestation question would soon be settled without artificial agency. But the existence of swamps and iron-pan, and the absence of adequate

protection from fire, grazing, etc., prevent the development of large areas of satisfactory woodland, and few attempts are made at present to turn this class of land to account, unless it happens to lie in the centre of a large estate.

In the north, the utility of most of the heath-covered waste for grouse moors and the grazing of black-faced sheep has invested it with a certain value which may vary from 1s. to 3s. 6d. per acre, according to its situation and capabilities. In most cases, therefore, we find that this land is either laid out in large enclosures, carrying a stock of from one to two sheep per acre during the summer months, or where the land rises to high elevations, or the surface is covered with deep peat or is bare of surface-soil, is given over entirely to grouse. In any case, we are dealing with a class of land which is practically in its unimproved condition, and which will not improve in fertility and is not likely to improve in value unless given artificial assistance. At the present time this artificial assistance is not readily given by those most intimately connected with it. Thorough drainage and artificial manuring would doubtless effect an improvement in this class of land, but whether this improvement would be accompanied by an adequate increase in its value either to the owner or occupier is another thing. Only the hardiest breeds, such as black-faced sheep and Highland cattle, are able to thrive on land of this description, and the latter, at any rate, have never been regarded as profitable sources of income to the ordinary farmer. We may, then, take it for granted that neither the existing nor the prospective values of mountain land for agricultural purposes are likely to increase, nor are its possibilities sufficient to encourage reclamation on an extensive scale.

Value of Waste Land for Planting.

The question which concerns us most closely as foresters, however, is the one which has been chosen for the title of this paper, and which has attracted the attention of rural economists to a considerable extent of late years. It has also been brought more prominently to the front by the social condition of a large proportion of the working classes bringing the question of employment in rural districts into the field of political inquiry. Enthusiasts draw glowing pictures of our now bare hill-sides

clothed with timber-crops, giving employment to a dense rural population, and bringing in a revenue which will extinguish the National Debt in the course of a century or so. They regard the indifference with which this subject has hitherto been treated, by landowners on the one hand, and the Government (usually the party to which they themselves do not belong) on the other, as little short of criminal, and contrast the condition of things in Great Britain as regards forestry with that prevailing in France or Germany. I am quite sure that we all feel it our duty, as foresters, to agree with a great deal of what they state. In France, Germany, Belgium, Austria-Hungary, and other countries on the Continent of Europe, we find the bulk of the mountain-land either covered with thriving forests, or energetic steps being taken to render it so. To say that such work has not only been successful from a sylvicultural point of view, but has also added considerably to the public revenue of those countries, is simply to state a well-known fact, and it might be worth while to inquire why it is that Great Britain presents such a striking contrast to continental countries in this respect. To answer this inquiry fully, however, would lead us too far from the point we are dealing with, and all that can be discussed this evening is the fact that such a difference does exist, and the question whether it continues to exist from natural or economic causes on the one side, or from sheer indifference on the part of those interested on the other.

Evidence For or Against the Planting of Waste Land.

The direct evidence that trees of various kinds will grow on our waste land and hill ranges is fairly conclusive. In the first place, we have the existence of scattered plantations of various sizes and various degrees of imperfection, to convince us that many kinds of trees will reach a fair size on suitable soils and situations, and at elevations up to 1000 and 1200 feet above sea-level. This much most people acquainted with tree-growth will allow, and no good purpose would be served by spending time in proving that such is the case. But the point which has never been satisfactorily settled is the extent to which planting on a large scale can be profitably carried out by an individual landowner, or a Government willing to invest large sums of money in this work for the good

of a future generation. To settle this point, it is not sufficient to prove that the trees will grow to any given size, or on any particular soil or situation, but it is necessary to demonstrate that a minimum quantity of timber can be produced per acre in a given time, and at a cost which is so much less than its market value that an average net return is left at the end of the rotation which exceeds the annual value of the land previous to planting. Of course, there are other features connected with afforestation which are of equal importance to that of its financial success. But we cannot ignore the fact that no prudent Government, and certainly no private individual, prudent or otherwise, will embark on a scheme of any magnitude which is likely to result in a dead loss as an investment. Yet, so far as any direct evidence is forthcoming, this is just as likely to be the result of afforestation as those high returns which optimists have figured out to their own satisfaction, if not altogether to the satisfaction of others.

We are only too ready to admit that instances of undoubted authenticity have been given of areas of waste land being planted, and yielding crops of timber the value of which has exceeded the cost of producing it, and left something substantial over. But if any great number of authentic records exist in this country of compact plantations of several hundred acres in extent having given a net return of any definite sum per acre, after allowing compound interest on all items of income and expenditure, I should be glad to know where they are. Any figures that I have seen or heard of usually miss out items which must inevitably have represented expenditure of some kind or other, or they refer to plantations of a few acres only, which rarely enable any satisfactory conclusions to be arrived at. In either case, we fail to get what we urgently require, viz., a definite statement which will prove that 5s., 10s., or 15s. per acre per annum, as the case may be, has been obtained from a number of blocks of 1000 acres or so of otherwise waste or semi-waste land by the process of afforestation.

If such a statement can be produced, it would go a long way towards establishing such proof as we require to make out a conclusive case for afforestation. But if not, then it is no use to sit down and do nothing for the next one hundred years or so, while investigators are working out their results from plantations now in their infancy. It does not require a health specialist

to convince a man of average common-sense that fresh air and good food are more conducive to good health than starvation and confinement, and in much the same way the most elementary knowledge of tree-growth will convince any man that thin soils and exposed situations are not so favourable for timber production as deep soils and sheltered valleys. But between these two extremes are a variety of soils and situations, at present practically bare of tree-growth, which constitute a large proportion of the semi-waste land of the country, and which it is clearly the duty of the advocate of afforestation to investigate as thoroughly as possible before asserting definitely that planting on this class of land will turn out a profitable undertaking. The question of the best method of carrying out this investigation has never, so far as I am aware, been dealt with in this country, and it was with the idea of bringing this important matter before the members of the Royal Scottish Arboricultural Society that I prepared this paper.

In my opinion, any method of arriving at definite conclusions on the value of waste land for planting purposes must be carried out more or less on the following lines. I must here ask you to remember, however, that I have in mind, not the planting of small areas, but the wholesale, but gradual, afforestation of a tract of country of several thousand acres at the least, and which is to be planted with the idea of turning it into a forest district.

Suitable Type of Area.

The first point to which attention should be directed is the selection of the area for investigation. To spend time and trouble on the first piece of waste land we come across might possibly lead to no useful result; as there is no close relationship between the existence of waste or semi-waste ground and its capacity or suitability for growing timber. As a suitable area for investigation, I should consider a district in which at least three-fourths of the land was incapable of intensive cultivation, or unworthy of artificial assistance from an agricultural point of view. With a few exceptions, such districts can only be met with, in the north at any rate, on hill ranges, and, in a general way, they may be said to lie at mean elevations of not less than 500 feet above sea-level. Below this level, the land is usually

already taken up by farms or plantations, and little remains to be done in the way of extensive afforestation.

The next point to consider is the proportion of waste land which appears suitable for profitable planting. Conclusions arrived at on this point must at first be regarded as of a preliminary nature only, but in a general way a little experience soon enables one to estimate, approximately, of course, the general value of waste land for planting purposes. Practically bare rock, exposed hill summits, ground covered with deep peat, elevated slopes facing the prevailing wind, and, generally speaking, all land over 1500 feet above sea-level, exclusive of river valleys, may be considered unfit for successful afforestation, exceptions, of course, simply proving the rule. A fair topographical knowledge of a district is usually sufficient to enable one to judge of the advisability of proceeding with or discontinuing the work of investigation, and if more than half the waste land of a district appears unsuitable for planting, or compact blocks from 500 to 1000 acres in extent cannot be found, it may be unwise to proceed further with it.

Another point of importance is the accessibility of an area, and its proximity to industrial centres, good roads, railways or waterways. It is a common contention that a sufficient and steady supply of good timber will always create a market, and in a general way this is probably correct. But even then, the cost of transport to a consuming centre has to be reckoned with, and unless natural facilities for this exist, the price obtained for the timber is often too low to allow a profit to be made on it. Good roads with easy gradients are probably of the first importance in this country, either for horse, steam or motor traction. In hill districts canals are usually out of the question, and rivers too shallow to be turned to account unless for stationary machinery. The existence of good main roads or railways will enable timber to be sold at some profit, other things being equal, for feeders to the main thoroughfares can always be provided when required, given sufficient timber to justify their cost. In the absence of any facilities for timber removal, it becomes, of course, a question whether the skill of the forest engineer can provide them at a justifiable cost at a later date, and the question of cost depends almost entirely upon the class of timber the land can produce. If only a small yield of an inferior quality appears possible, it is very doubtful if timber-growing, under present

conditions, can be made to pay at all, as we shall see more clearly later on.

Investigations on Tree-Growth and the Factors of Locality.

The above are the chief points to which attention should be directed in the first stages of inquiry. The next step constitutes the real work which investigations of this kind involve, viz., the attempt to ascertain the rate of tree-growth in the district. This work is attended with great difficulties, owing to the fact that not only are woods in such districts as we are considering often few and far between, but where they do exist, their condition is far from perfect, and they can rarely be regarded as fair examples of what the soil and climate are able to produce. To consider them alone would, therefore, seldom result in any satisfactory conclusions being arrived at, and in Great Britain, at any rate, we are obliged to extend our investigations to the soils and situations which the district presents to us bare of timber-trees, and which have probably never borne trees within the memory of man.

Tree-Growth.

Taking the former of these branches of investigation into consideration first, it is not difficult to realise its importance, and the great disadvantage of having to conduct our inquiries under existing adverse conditions. For without normal tree-growth to serve as a standard, it is practically impossible to ascertain the value of the local climate as a factor of growth, for however closely soils and situations may be studied, the effect of climate still remains an unknown factor in the development of timber-trees.

On the Continent, and particularly in Germany, invaluable work has been done by the accurate measurement of sample areas of pure woodland of various ages, and growing on different soils and situations. By such measurements, which are made in the various forest districts throughout the country under precisely the same system of measurement, the effect of local climate can be seen to a tolerable nicety, and the development of different species followed without difficulty. With the aid of the "yield tables," thus obtained, the value of the land for sylvicultural purposes can be ascertained, and the period at

which any given crop is likely to reach maturity predicted. In Great Britain no reliable records of this kind have been made, and it is almost impossible to say what our soil is capable of producing if managed on proper lines. Most British measurements of tree-growth have hitherto been confined to individual trees, remarkable either for their exceptional size, rarity, or some historic interest attaching to them. These records, although highly interesting up to a certain point, rarely enable the forester to arrive at any conclusion as to the normal or abnormal character of the growth of the trees in question. In the case of common forest trees of the country, it is, of course, not difficult to recognise the relative size of any given individual of known dimensions, provided the soil, situation and age are given, and compare it with the general average of the species throughout the country. But it is impossible to tell whether such an individual is a normal or abnormal specimen for that particular district, unless the information is supplemented by further particulars regarding those round about it. With old trees, again, the age is often difficult to ascertain, while the dimensions of the tree at eighty or a hundred years, the ages at which most forest crops are cut, are unknown, and the rate of what may be termed their economic growth cannot be ascertained. Measurements of ornamental trees, such as conifers, are usually accompanied by particulars of age, soil and situation, so that it is often possible to obtain some idea of their rate of growth within a given time. But unless such trees are sufficiently numerous to enable an average rate of growth over a definite area to be struck, they rarely justify any reliable conclusions being arrived at. Take, for instance, the case of a certain species being represented by a single individual, or by eight or ten widely separated trees. The rate of growth of the one, or the average rates of growth of the whole, do not afford any clear indication of what might be expected from a forest crop of that species, covering, say, 5 or 10 acres of ground. The single individual may possibly be growing on a spot which is not typical of the surrounding soil, while the widely separated trees may respectively be growing on soils and situations varying in different directions, and effectively preventing any connection being traced between their conditions and the average rate of growth of the trees. But when a sufficient number of trees of one species are found on a definite area, all being of the same age, and all growing on the same

class of soil, and with the same aspect, slope, etc., it is generally possible to obtain a good general idea of their rate of growth for any given period by ascertaining the average size of the trees. In this way, the general rate of development of a species may be found for that particular soil, situation, etc., in the district. But the conditions under which the trees have been grown as regards space, determine whether the results are of any *value* to the forester or not. If grown sufficiently close together to secure branch suppression on the one hand, and the maximum production of timber throughout all stages of growth on the other, the yield-capacity of the soil can be ascertained without difficulty. But if they have been standing so far apart as to render the development of the trees other than what they would be in a thick wood, no absolutely definite information can be obtained which will show the maximum quantity of marketable timber capable of being produced in a given number of years, and it is therefore impossible to say what return the land is able to make upon the capital invested in planting it.

It is in the general absence of trees grown under the former conditions in this country, and more especially their absence in hill districts, which renders the work of collecting useful data so difficult. In Germany, where State forests have been in existence for several centuries, the presence of thick forest crops, of all ages, is so general throughout the country that the number of measured plots is chiefly determined by the expense and time involved in dealing with them. In Great Britain, however, instances of really thick and full crops of more than fifty years of age, and covering an area of one acre or so of ground, are so scarce that one almost despairs of finding sufficient to make the results of measuring worth recording. With younger crops, things are somewhat better, but even with these, their existence on high-lying hill land is very limited, and it is only by careful search, and the use of more or less imperfect material, that any great number can be found in individual districts.

The chief defects in hill plantations are usually associated with their lack of management from the time of planting onwards. It is, of course, an understood thing that many of the smaller of these plantations were formed with little or no idea of growing commercial timber, but simply for the purpose of providing shelter for stock, farm-houses, or cottages. One result of this is that they are often planted in situations and under conditions

which are sufficient in themselves to preclude the possibility of success. Their size is too small to enable the trees to derive any benefit from mutual shelter, and this is often aggravated by their occupying exposed points and ridges, while they frequently consist of species which are not adapted for timber production at all, and no use can be made of them.

In larger plantations, which might be expected to provide valuable material, the most frequent causes of bad condition are met with in badly drained soils, early and excessive thinnings for the sake of fencing materials, the use of the plantations for grazing purposes, and a general absence of systematic management from the time of planting onwards, chiefly due to their distance from headquarters. Add to these the fact that pure plantations are the exception rather than the rule, and it can be understood how difficult it is to find material of a suitable character. Yet if searched for, material does exist which is worth making use of, as I hope to show presently.

During the time I have been in the North of England, I have made a modest attempt to get together data of a character which would bear some resemblance to the results already obtained in Germany and elsewhere. As yet, the actual results are so insignificant as to hardly deserve mentioning, but a brief description of the more important might be of interest to some of you.

Up to date, sample plots of Scots pine, spruce, larch, and Corsican pine have been measured in three centres, Dipton, Healey and Ashgill. Of these plots, five are Scots pine, six spruce, two larch and one Corsican pine, while other centres have been selected for future work. The following description of these centres will enable an opinion to be formed of the classes of soil and situation in each, the figures relating to the plots being given in the Appendix (see pages 166 and 167).

Dipton Centre.

Dipton, and the immediately adjoining woods, are the property of the Duke of Northumberland, the executors of the late Mrs Backhouse, and Mr W. C. B. Beaumont, M.P. The total area is about 1500 to 2000 acres, the greater part of which occupies land which was enclosed a little over one hundred years back, and planted by the Governors of Greenwich Hospital, then the owners of the land. The soil varies from clay to fine sand and coarse gravel resting on the Millstone Grit, having an unimproved agricultural value of 2s. to 3s. per acre. The elevation varies from 300 to 600 feet above sea-level, and the general slope of the ground is towards the north, north-west, and north-east. The natural surface vegetation is heather or coarse grass, birch being the predominant indigenous

tree. This centre lies on the extreme edge of the area under investigation, and adjoins the Tyne valley above Corbridge.

The chief forest crops are Scots pine and larch, with a little spruce and hardwood timber. The Scots pine in both the Duke's and Mr Beaumont's portions is exceptionally fine, while the latter has probably the finest larch, both in the form of crops and individual trees, to be found in the country. In the Duke of Northumberland's portion, amounting to about 800 acres, a systematic course of clearing and replanting is proceeding under the direction of Mr A. T. Gillanders. Mr Beaumont's portion is under the charge of Mr J. Balden, the resident agent, and probably few estates in the country can show a larger quantity of well-grown timber.

Healey Estate.

This estate lies about two miles to the south-east of Dipton, and is the property of Mr Warde Aldam, whose predecessor, Mr Ormston, purchased the property in 1816, and during his lifetime cut and cleared the greater part of the woodland area then existing, while further plantations were formed until the extent of woodland amounted to about 1700 acres. During the period of clearing, one plantation alone is said to have realised £20,000, while altogether about £56,000 worth of timber was sold during this period, pit-wood at that time commanding a high price.

The soils are very similar in character and agricultural nature to those at Dipton, but the elevations here rise to 1000 feet, while the surface slopes rather more uniformly towards the north-east. The whole of the younger woods consist of Scots pine and larch, with a small proportion of spruce and Corsican pine. The Scots pine generally is doing well, but the larch varies in quality a good deal, and in many places fails to grow beyond pit-wood size.

For the best part of a century, the woods have been managed by Mr Matthew Jewitt, the present forester, and his father before him, both of whom have evidently fulfilled their trust to the advantage of the estate.

Ashgill Wood—Alston.

This is a plantation of about 300 acres, belonging to the Greenwich Hospital Estates (which are under the management of Mr John Davidson), to which it was added two years ago. This wood lies about midway between Cross Fell, the highest point of the Pennines, and the lead-mining village of Nenthead, and is fairly well sheltered by the former from the full force of the south-west wind. The elevation of this wood varies between 1250 feet along the bed of the South Tyne, and 2000 feet at the highest point of a shelter-belt which was planted in advance of the main crop. The greater part of the wood lies between 1500 and 1800 feet, and slopes gently towards the north-west, a deep ravine cutting through the eastern side. The soil is chiefly composed of glacial clay resting on Yoredale limestone, the surface being covered with a foot or two of peat. The unimproved agricultural value of the surrounding ground is probably about 3s. 6d. per acre, the natural soil being of a more fertile character than those resting on the Millstone Grit.

The present crop in this wood is practically pure spruce, White American having been mixed slightly with the European species. A few larch and broad-leaved trees are present, but are too small in number and stunted in character to be worth considering. The

spruce forms a thick even crop about 50 to 55 years of age, average individuals containing about 20 cubic feet of timber, the largest trees running up to 50 feet cubic contents. On exposed margins the White American species has succeeded much the better of the two, and at the highest point of the shelter-belt a small clump has attained a height of 10 to 15 feet, where neither Norway spruce nor larch have been able to rise above the wall forming the boundary. At 1800 feet, on damp, peaty ground, the same species has reached a height of 30 feet, and is perfectly healthy, and the foliage entirely unaffected by cold winds which redden the needles of the common spruce. Lower down, where the two have been mixed together, the American species has quite held its own, but Mr Davidson states that it has been found much more liable to heart-rot than the common spruce.

Mr Richardson, of Garrgill, who assisted in the planting of this wood, has been kind enough to furnish the following particulars of its past history:—Previous to 1850 the wood, which was then owned by the London Lead Company, was carrying a crop of young larch badly affected by disease and aphis. In 1851 to 1852 the ground was cleared of larch, which was then large enough for fence-rails, pit-timber, etc., and the branches burned on the ground. The part now occupied by pure spruce was prepared by cutting open drains 6 feet apart, 3 feet wide, and 2½ feet deep, and the material taken out spread regularly over the ground between them. This was done in the summer or autumn, and the ground planted in the following March. In other places, pits were prepared by cutting circular sods 15 or 18 inches in diameter, and the soil below taken out, and allowed to weather before planting, the sod then being placed grass downwards on the surface again. Other species tried here were Scots, American, Corsican and mountain pines, and ash, elm, poplars, beech, sycamore, etc., but all failed except spruce, beech, and Scots pine. The last-named is doing well on dry ground near the South Tyne, and beech and sycamore succeed well enough for shelter; but for all practical purposes spruce is the only tree which attains to any commercial value on the clayey subsoil. Where the latter consists of gravel, and the ground is well sheltered, as in the Gills, larch has attained dimensions of 20 to 30 cubic feet in the past, but it appears to be too risky a crop for trying on a large scale. Ash also reaches a size which can be turned to account for handle wood, shafts, etc., and from the name "Ashgill" is probably indigenous, and beech attains a fair timber size on well drained ground.

At the present time the spruce is being gradually cut in sections, and a ready sale at 6d. per cubic foot is found for it as pit-timber, for use in the Nenthead lead-mines. As shown in the table appended, an average annual increment of 60 cubic feet has been obtained from the ground, so that a gross rental of something like 30s. per acre per annum is being obtained from the best portions. Allowing for bad and unproductive ground, and estimating the annual cost of management, replanting, etc., at 10s. per acre, it is evident that a net annual return of 10s. to 20s. per acre is possible from this ground under present conditions. This, of course, is due to the exceptionally favourable conditions which exist for disposing of the timber, and which enable a price to be obtained for it which is probably fully double the average price which might be anticipated in such a locality under ordinary circumstances.

Langdon Beck plantation, in which Plot 6 was measured, lies

about eight miles from Ashgill, in the upper valley of the Tees, and is the property of Lord Bernard. The class of land resembles in every respect that round Ashgill, and the chief difference between the two plantations is one of size, Langdon Beck being not more than twenty acres in extent, and, consequently, more affected by wind than many parts of Ashgill.

Before placing any value upon the figures which relate to the above-mentioned centres, it is necessary to remember that they refer to sample plots which were selected on account of the exceptionally thick crops which stood upon them, and which were as near the maximum carrying capacity of the soil as possible. They must not be regarded, therefore, as indicating the volume or value of an average crop of the same age and species actually growing on the soil and situation, but rather as a proof that such a crop is possible where the conditions are fairly uniform, and correspond to those under which the sample plot was grown.

Another point to remember is the fact that no information was obtainable which would show the actual volume removed from the plots in previous thinnings. In some cases, especially in the younger plots, this would be so small that it may safely be ignored altogether. In others, it would probably place quite a different value upon the soil for timber-growing to that indicated by the figures given. One point, however, seems to be brought out fairly clearly, and that is that two crops of the same age may have practically the same volume on the ground, although growing on soils and situations varying considerably in quality. The difference between a good and bad sylvicultural locality appears to lie in the large size to which individual trees attain, and the increased volume of the thinnings, which have resulted in the greater reduction of the stems per acre at the maturity of the crop in the former. The average annual increment of the standing crop alone, therefore, must not be regarded as a true guide to the value of the locality for timber-growing, as the market value of a cubic foot will probably be greater where the individual trees are large than where they are small, other things being equal. The most valuable guide in this point, so far as the standing crop alone is concerned, is probably the average height-growth to which the trees have attained in a given time and under similar sylvicultural conditions, and this point is of special importance in connection with comparative statements of British and German sample plots.[1]

Factors of Locality.

The second method of valuing land for timber production is one which, under present conditions, is probably of greater utility than that of sample plots, although the one should be a confirmation of the other. But the area of mountain land, or that of a similar character to the waste land of the country which already carries a crop of timber-trees, is so insignificant that the intending planter has little opportunity to take existing plantations as a guide in making a choice of species or deciding

[1] Reprinted from the Report on *Forestry Work during* 1904-1906, published by Armstrong College, Newcastle-upon-Tyne, 1906.

whether a crop of timber is likely to prove a success or failure on a particular site. In a general way, it is true, the conditions under which trees grow are sufficiently well known to enable a forester of any experience to describe a locality as good, bad, or indifferent, or to say with reasonable certainty that Scots pine or spruce will grow here, or oak and ash there. So far, no great difficulties present themselves. But when the finer distinctions between various localities are separated into their component parts, as they must be when a detailed examination is made of them, it is very difficult to say what value can be placed upon them individually. Local climate, soil and situation are all extremely complicated factors which co-operate in producing a definite effect upon plant-growth, but the relative importance of each cannot be estimated with any great accuracy. All we know is that they vary the rate of growth, the quality and quantity of the timber, and the final development of any particular crop to an extent which may render a profit possible in one place, or result in a loss in another. Where these factors are well pronounced, as in the case of a wet or dry climate, a clayey or sandy soil, or an exposed or sheltered situation, their effect can usually be recognised, and, according to the species concerned, may be favourable or the reverse. But when they are either so obscure, or influence one another to an unusual extent, it is practically impossible to estimate the effect of any one of them individually, and a great deal of planting work must always be of a speculative character for this reason.

Assessment of Locality.

The point which is, after all, of most importance in connection with our subject, however, is the extent to which reliable conclusions can be drawn from a careful examination of the various features of local climate, situation and soil. The question is not so much the extent to which a combination of good or bad features, or factors of locality, influence tree-growth, but how far antagonistic factors go to create neutrality within their limited area of influence. How far, for instance, does a good soil evidently compensate for a bad situation, a wet soil for a dry climate, or a well-covered aspect for a windy or exposed district? In answering this question, nothing of a very definite nature can be attempted, as each case is peculiar, and everything depends upon the limit which is placed in such cases upon the choice of species. Apart from conditions which

absolutely preclude the possibility of tree-growth, hardly a locality can be found which will not grow something or other. But financial considerations compel us not only to limit ourselves to species which have a recognised position in the timber-trade, but also to those which can produce the required quantity of timber in a given time. Such species will probably be found very few in number. Spruce, Scots and Corsican pines, larch and, to a limited extent, Douglas fir among the conifers, and beech, birch, sycamore, and a little oak and ash, among broad-leaved trees, are probably all that can be grown on a commercial basis on ordinary hill land. Of these, spruce and pines are the only species which can be depended upon on a large scale at high elevations, and as trees for which a regular market exists. Larch, of course, pays better than any where it succeeds, but its success is too problematical to allow great dependence to be placed upon it, while Douglas fir requires conditions of an exceptional nature for its success. The demand for most of the broad-leaved trees is too limited for extensive planting of them to be entertained, even supposing that they can be grown on much of the land we are considering. It seems probable, however, that beech might be more extensively grown up to 1000 feet or so than it has been in the past, not only for the sake of its timber, but owing to its favourable effect upon soil fertility, and its power of resisting wind. Both birch and sycamore are hardy enough for most localities, but it is doubtful if their growth would pay on a large scale, while oak and ash could only have a very limited existence at the best.

To stand on comparatively secure ground, therefore, we must regard spruce and pines as the mainstay of our hill timber-crops, leaving the others to come in as soil, situation and local markets may occur to render their cultivation advisable. As regards spruce, I am aware that it is an every-day experience that it cannot be given away even when grown. But facts which apply to small, isolated lots, many of which consist of trees which would produce tears in an American lumber camp, or cause a hardware manufacturer to extend his works, may not necessarily apply to large areas of properly grown timber, and it is not necessary to regard this species as hopeless because it has been abused hitherto.

Taking these two species, then, as those for which the suitability of a locality must be judged, the method of assessment

remains to be considered. It is impossible to place a precise value upon any unplanted land for the growing of a particular species, it is true, but it certainly seems desirable to obtain something more definite than the bare classification of a locality as good, bad or indifferent if possible, and, at any rate, no objection can exist for the reasons which lead to any classification being given. The only method which seems in any way to meet the requirements of the case is that of placing unit values upon the various factors of locality by points, as shown in the following Table:—

ASSESSMENT OF SYLVICULTURAL LOCALITY.

	Points.		
	+	Average.	−
1. SURFACE SOIL.—Minimum Depth—1 ft.,	...	...	1
,, ,, 2 ft.,	...	1	...
,, ,, 3 ft.,	1	...	...
2. SUBSOIL.—Impervious,	...	...	1
Rocky,	...	1	...
Open,	1	...	...
3. MOISTURE.—Very Wet or Dry,	...	...	1
Moderately Wet or Dry,	...	1	...
Fresh,	1	...	...
4. CHARACTER.—Clay, Sand, or Peat,	...	...	1
Clayey, Sandy, or Peaty,	...	1	...
Loam,	1	...	...
5. SITUATION.—			
Elevation—Above 1200 ft.,	...	...	3
,, 750 to 1200 ft.,	...	3	...
,, Below 750 ft.,	3	...	...
6. ASPECT.—S.W. or W.,	...	...	1
N., S., N.W., S.E., or Flat,	...	1	...
N.E. or E.,	1	...	...
7. EXPOSURE.—Full,	...	...	1
Moderate,	...	1	...
Slight,	1	...	...
8. SLOPE.—Over 25 per cent.,	...	...	1
10 per cent. to 25 per cent.,	...	1	...
Flat or under 10 per cent.,	1	...	...
Over 10 Points = Good Locality,	+(×a)		−(deducted)
,, 10 ,, = Average Locality,	10	10	10
,, 10 ,, = Bad Locality,			

In this Table, the unit values placed upon several factors must vary with the species and local climate. Altitude, depth and character of soil, and, to a less extent, aspect and exposure, all vary in their importance with the degree to which they affect the species, and with the manner by which they are in turn affected by the climate. No attempt has been made, therefore, to place any value upon the latter, as it may be assumed to exert a fairly uniform influence upon localities which are similar in other respects, and which exist in the same district. No attempt should be made, however, to compare localities assessed in two widely-separated districts, or in districts with different physical features, as it is obvious that the precise climatic conditions cannot be the same.

As an example of this method of assessment, the sylvicultural value of the sample plot in Dipton Wood, which has already been referred to, may be given as follows:—

ANALYSIS OF LOCALITY—DIPTON WOOD.

	+(×2)	Average.	−(Deducted).		
I. SOIL.					
Surface Soil—Over 3 feet, .	1	...			
Subsoil—Impervious, . .	...	...	1		
Moisture—Fresh, . . .	1	...			
Character—Loamy, . .	1	...			
II. SITUATION.					
Elevation—Below 750 feet, .	3	...			
Aspect—N.E., . . .	1	...			
Exposure—Moderate, . .	...	1			
Slope—Below 10 per cent., .	1	...			
	8	1	1	=(16+1−1)	16

Placing a value of 5 cubic feet per acre per annum on all points in the first and second column, we should obtain an annual yield of 80 cubic feet per acre on a full rotation. Comparing this estimate with what is actually on the ground in another sample plot a hundred years of age, growing on a similar situation but rather lighter soil close by, we find that the latter agrees with the estimate. That it will do so in all cases, however, is

very unlikely, but it, at any rate, gives us some definite basis to work on, whatever the actual values placed upon the units may be. In both these instances, conditions exist which must be considered exceptionally favourable, both as regards locality and the density of the crop on the ground.

The great difficulty of satisfactorily applying this method of assessment to ordinary hill land often lies in the fact that the quality of the locality is constantly changing. Soil varies in depth, quality and character in the course of a few yards; elevation and aspect are continually changing on undulating ground, and other changes take place which render it difficult to strike a fair average for a large area. But still it is often possible to find areas of two or three hundred acres with the same aspect and degree of slope, and fairly uniform as regards soil, and with such areas this method should give satisfactory results. With the aid of the 6-inch Ordnance Sheets, the ground can be blocked out into areas with similar aspects, slopes, and elevations, leaving the soil and minor districts to be examined on the spot.

With the assistance of such a method of analysis, and careful observations on the growth and development of whatever trees or plantations may exist in the vicinity, it should be possible to obtain a fairly accurate estimate of the value of waste land for planting purposes. The question as to whether such work as I have sketched should be carried out by public or private agency is a matter which does not affect the principles of the method itself, but simply the extent to which it can be practised. So far as the latter method of assessment goes, it can, of course, only be applied to definite areas upon which planting is contemplated, and must be left more or less to the public or private landowner, or his representative. No private landowner plants without a definite object in view, and, before planting, he usually obtains the advice of his agent or forester as to the suitability of the spot he wishes to plant. The condition of many plantations at the present day suggest either that this advice was not always acted upon, or that its quality was not of the best when given. But so many incidents happen in the life of a plantation, that it is impossible to diagnose every case of sylvicultural debility which is met with from time to time, and the best course is to study future methods of reform rather than regret the past.

The work of sample plot measurement and recording can only be properly undertaken by some institution which concerns itself with forestry education and investigation. To be of any value, they must be made over a fairly wide area, and on a number of different estates, and the selection of plots can only be carried out satisfactorily by those who have made special study of such work, and are able to form an opinion as to the relative merits of individual plots. The actual measurements can, of course, be made in many instances by those on the spot, but the true significance of the figures obtained can only be appreciated by those having a fairly extensive acquaintance with the woods of the district generally, and able to arrive at reliable conclusions.

Minimum Requirements.

The next question is: Given land of a certain productive power, what quantity of timber must it produce to pay rent after allowing for the costs of planting and maintenance? This is not an easy question to answer, as it depends upon so many points which are constantly varying in character, and which render the experiences of one district of little or no value in another. The initial costs of planting are probably the easiest to estimate, as their variations in different districts are not so great, and a general average can more easily be struck. Legitimate maintenance charges, again, are not difficult to estimate for a large and compact area, as it is assumed that economic planting is only contemplated when carried out on a large scale. As a matter of fact, given the rent of the land, the average annual costs of production can be estimated with tolerable accuracy, and the debtor side of the account can be arrived at without difficulty. The annual costs may be made up somewhat roughly as follows:—Rent of land, 2s. 6d.; rates and taxes, 1s.; interest on planting and fencing costs during first 25 years, 4s.; maintenance, 2s. 6d.; total, 10s. per acre per annum as the annual cost of keeping a growing crop on the ground.

But when one comes to estimate the covering of this cost by a given yield of timber, the problem is a difficult one. If timber of a given size had a definite and fixed value in the market, it would not be a difficult matter to find the number of cubic feet necessary to produce the sum required. But, as is well known,

none can say with certainty, or even with probability, that a certain class of timber on a certain area will be worth any definite price per cubic foot in 60, 80, or 100 years' time, as the case may be. We have, it is true, existing prices to work upon, but these are of little value beyond giving us some idea of the way in which the prices of timber are affected by size of individual trees, distance from railway or market, and so forth, enabling us to fix, with some probability, relative but not absolute values. Such approximate estimates, however, may be easily affected by changes in industries which now use timber as their raw material; or by an increase or decrease in the costs of conversion or transit. That such changes are likely to occur in the future, there seems to be good reason for believing, but how far they will go, none can say. At the present moment it is absolutely impossible to make a reliable estimate as to the future value of any given quality of timber in districts where it is constantly coming on the market, and where the manner in which its price is affected by local surroundings is fairly well known. It is evident, therefore, that such estimates in connection with remote districts, in which timber has never existed or been sold within living memory, are practically valueless, and that the question of what constitutes a profitable yield can only be answered within fairly wide limits.

Several important points in connection with this question, however, are worth considering. These are, first, the probability or otherwise of timber generally increasing in value, and second, the size to which individual trees can attain on the land proposed for planting. An increase in the price of timber has long been predicted. Ancient timber merchants tell us that their grandfathers had sad forebodings of the coming timber famine, and students of old forestry literature will recollect that Evelyn, and writers before Evelyn, lamented the growing scarcity of timber in their time. But imports of timber still continue, and prices do not show any indication of short supplies at present. Probably the fact is that the existing supplies of timber are sufficient so long as the supplies of iron and coal hold out, for it must be remembered that wood is used for many structural purposes because it is cheaper and lighter than iron, and not merely because the latter is unsuitable; while its extensive use for fuel is prohibited because it is dearer than coal. For many purposes, therefore, high-class timber could be dispensed with if its

relative price rose above that of iron, while abundant coal supplies prevent a large proportion of the cheaper and inferior wood being turned to account as fuel. So far as Great Britain is concerned, anxiety on account of a timber famine seems a little premature, taking the fact into consideration that the countries from which most of our supplies are drawn, Canada, Scandinavia and Russia, have enormous areas of land which are intended by Nature for timber-growing, and that little or no inducement exists to turn them to any other purpose. But although a timber famine may be a thing of the remote future, it is quite possible that a considerable rise in the price of the better classes of timber may occur before many more years. This may be due to such causes as the increased cost of conversion and transit of foreign wood, the necessity for artificial rather than natural methods of reproduction, and the tendency to cut timber before the trees reach their maximum size, which is invariably the first effect of an increased demand. The first result of such a rise in price would be that other materials would be used for many purposes for which such timber is now employed, and that increased economy would be effected in the use of timber all round, which would react upon the price to some extent. We already see such agencies as these at work in the increased use of iron in building construction, railway sleepers, fences, telegraph poles, pit-props, and in hundreds of other directions; while economy in its use is being exercised by preservative processes, such as creosoting, etc., which render young, immature trees as valuable as fully developed timber in its natural condition. But in spite of economy being exercised in these directions, it is practically certain that any considerable curtailment of the present imports of timber would result (assuming, of course, that the present consumption continued) in a rapid rise in price of the better class of timber which cannot be produced in a short period, and for which substitutes cannot so readily be found. Whether this increase would be shared by the smaller classes of timber, which are now difficult to dispose of at any distance from a market, is another matter, but one which is of paramount importance in discussing the planting of waste land. As every practical forester knows, high and exposed ground can only produce a very small proportion of large trees, as compared with ground at lower elevations. At high elevations, larger areas of poor, thin soil exist, while

the local climate also becomes less suitable for growing large timber. Pit-props or pulp-wood are about the only classes of timber which could be produced on such land, but at the present moment the cost of carriage prohibits such timber being utilised for pit-props unless within a short distance of a colliery or with cheap water carriage, while pulping-mills do not exist, one reason being, that the timber for keeping them running has not yet been grown. What would happen with large and regular supplies is another matter, and all we can say with certainty is that a satisfactory market has to be found for Scots pine, spruce and larch, the average size of which would not exceed 10 to 20 cubic feet per tree, if the planting of hill land is to be a financial success. At the present time, we know prices for this class of timber are not satisfactory, although the price of larch enables a little profit to be made. But as there is little or no certainty about larch succeeding over large areas, we can only depend with certainty upon the other two for permanent crops. The average price for these two species at present is about 2d. per cubic foot, leaving out of account altogether remote plantations from which timber cannot be sold at all. With an average rate of growth of 50 feet per acre per annum, this price brings in 8s. 4d. gross rental, which is equal to a loss of about 2s. per acre if our former supposition of annual costs is correct. With an average price of 3d. per foot, this loss would be converted into a gain, but only to the extent of a rental equal to that paid by the land in its unimproved state. To obtain any clear financial advantage from planting this class of land, therefore, we must get an average price of 4d. per cubic foot, which should bring in a net rental of about 5s. per acre. On favourable localities, we should gain a further advantage in the yield of timber and the larger size of individual trees, and in convenient situations a better relative price could be obtained, and it is not difficult to prove that planting pays under such circumstances. But, taking the average yield of 10,000 acres of land lying between 500 and 1500 feet above sea-level, I think we should find that the yield of 50 cubic feet is, if anything, too high, because a certain proportion of this class of land must be allowed for as non-productive. Peat-bogs, swamps, bare or only thinly-covered rock, are sure to occur to a greater or less extent at elevations over 1000 feet, and tend to reduce the average yield per acre, and although the cost of planting such land may

be saved, other charges have to be incurred in connection with it, such as fencing, rates and taxes, etc., which increase the expense without increasing the revenue. The greater the elevation, the greater the probability of these unproductive patches of ground occurring, until, at elevations over 1500 feet, the chances are that the area of really timber-producing ground is too small to be worth troubling about, supposing that no other unfavourable conditions exist.

Although the final results of the careful investigation of this important question cannot be fully anticipated, the probabilities are that they will prove that timber-crops of spruce and pine can be grown at a profitable rate up to 1500 feet on suitable soils and aspects, and where the mean elevation of the ground to windward is sufficiently great to afford shelter from the full force of the wind. Where the elevation does not exceed 1200 or 1500 feet, or on westerly aspects, the generally accepted fact that the 1000 feet contour-line marks the limit of profitable tree-growth will probably be confirmed in a general way, although exceptions may occur here and there which may prove that limit too low in one place or too high in another. These anticipations, however, are based upon the assumption that the timber is grown in blocks with an average area of 1000 acres or so, and that a minimum price of 10s. per load can be obtained for it in the wood. If the long-threatened timber famine is upon us, there is every prospect that such a price may be obtained for timber offered under proper conditions, and in sufficient quantities to allow of economies being effected in its handling and conversion.

SAMPLE PLOTS MEASURED DU

I

No. of Plot.	Species.	Name of Wood.	Elevation.	Geological Formation.	Soil and Subsoil.	Aspect.	Slop
1	Scots Pine .	Dipton . . .	550	Millstone Grit.	Peaty Sand on Clayey Loam.	N.W.	Under 1
2	,, .	,, . . .	500	,,	Gritty Sand .	S.W.	,,
3	,, .	,, (70 acres)	550	,,	Fine Fresh Sand.	N.E.	,,
4	,, .	Snokoe . . .	550	,,	Sand on Sandstone Rubble.	W.	25 %
5	Larch . .	Dipton . . .	350	,,	Sandstone Débris.	E.	,,
6	,, . .	Sunnyside . .	300	,,	Sandy Loam .	S.	Under 10
							He
1	Scots Pine .	Sunnyside . .	800	Millstone Grit.	Gritty Sand .	N.	Under 10
2	Corsican Pine	,, . .	800	,,	Sandy Loam on Sandstone Rubble.	N.	,,
							Ash
1	Spruce . .	Ashgill . . .	1700	Yoredale Rocks (Limestone).	Peaty Soil on Clay.	W.	Under 10°
2	,, . .	,, . . .	1600	,,	Peat on Stiff Clay.	N.W.	,,
3	,, . .	,, . . .	1600	,,	About 12 inches Peat on White Clay.	N.	,,
4	,, . .	,, . . .	1600	,,	Peat on Clay .	N.	,,
5	,, . .	Tyneside Plantation.	1250	,,	Alluvial Soil on Limestone Rubble.	...	Flat ground
6	,, . .	Langdon Beck .	1300	Boulder Clay.	Clayey Loam.	N.E.	Under 10°

RS OF 1904–5 AND 1905–6.

ure.	Natural Surface Growth.	Area of Plot.	Age.	Stem Group.	No. of Stems.	Stem Basal Area.	Average Height	Average Q.G.B.	Volume (S.B.A. × H. × F).	Equal per Acre. Total Volume	Equal per Acre. Average Annual Increment.
						Sq. Ft.	Ft.	In.			
rate	Heather .	1 acre	30	I.	232	53·2	36	5⅝	766	1718	57
				II.	601	65·4	32	4	837		
				III.	240	10·3	28	2½	115		
g .	,, .	¼ ,,	30	I.	87	10·9	35	4¼	152	1672	56
				II.	245	17·8	32	3¼	227		
				III.	89	3·5	28	2⅜	39		
t .	,, .	1 ,,	100	I.	38	80·0	80	17⅜	3200	7693	77
				II.	103	136·9	72	13¾	3928		
				III.	36	22·1	64	9⅜	565		
g .	Grass . .	⅛ ,,	100	I.	12	13·6	65	12¾	442	8040	80
				II.	35	20·0	59	9	472		
				III.	11	4·4	52	7½	91		
ered	Ferns . .	⅛ ,,	70 (?)	I.	7	9·5	100	14	475	6110	87 (?)
				II.	21	17·6	90	11	633		
				III.	7	3·5	80	8½	112		
t .	Grass . .	¼ ,,	60	I.	7	8·89	80	13⅜	353	4048	67
				II.	21	19·26	72	11⅜	554		
				III.	7	4·13	64	9⅜	105		
':											
ered	Heather .	¼ acre	48	I.	31	13·0	40	8⅛	208	2472	51
				II.	91	26·6	36	6½	354		
				III.	33	4·4	32	4⅜	56		
erate	,, .	⅛ ,,	45	I.	13	9·64	55	10½	212	3310	73
				II.	39	19·0	50	8½	380		
				III.	13	3·9	45	6⅛	70		
':											
erate	Heather .	⅛ acre	45	I.	13	8·0	45	9⅛	144	3504	77
				II.	44	16·0	40	7¼	256		
				III.	15	2·7	36	5⅛	38		
,	,, .	⅛ ,,	50	I.	13	9·0	55	9⅞	198	3968	79
				II.	37	12·6	50	7	252		
				III.	15	2·6	45	5	46		
,	,, .	¼ ,,	50	I.	28	17·7	45	9½	318	3332	66
				II.	88	27·1	40	6¼	433		
				III.	36	5·7	36	4⅛	82		
,	,, .	⅛ ,,	55	I.	12	8·4	50	10	168	3408	62
				II.	28	12·5	45	7½	225		
				III.	19	2·1	40	5⅜	33		
tered	Coarse Grass	¼ ,,	55	I.	16	15·3	75	11⅜	459	4528	82
				II.	41	21·6	68	8¾	587		
				III.	15	3·6	60	6½	86		
erate	,,	⅛ ,,	32	I.	13	5·2	40	7½	83	2416	75
				II.	45	13·5	34	6½	183		
				III.	16	3·0	30	5¼	36		

20. A Century of Forestry—1806 to 1906—on the Estate of Learney, Aberdeenshire.

(*With Plan.*)

By the late Lieut.-Colonel FRANCIS N. INNES.

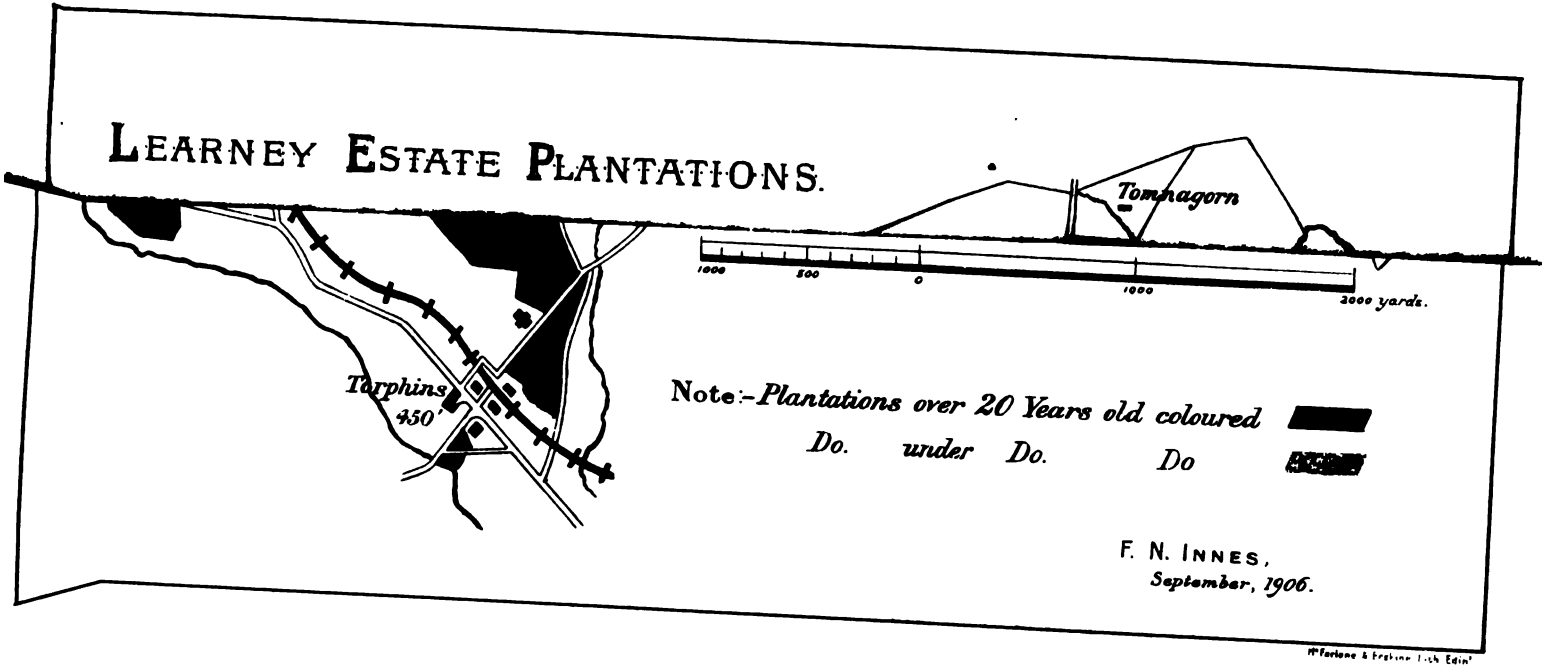
The following memorandum, with its accompanying sketch-plan and schedule, has been drawn up to exhibit a succinct account of the Forestry transactions carried on during the past 100 years on an average-sized upland Aberdeenshire estate, which contains a fair proportion of arable ground, woodland and moorland—thus illustrating the period during which Forestry may be said in some measure, although imperfectly, to have developed in the North-East of Scotland into an example of applied science.

The Learney Estate comprises about 4081 acres, of which 1870 are arable, 1589 are, or have been, under wood, and the remaining 622 acres are buildings, roads, water, moorland, etc.

The elevation of the estate area rises from about 400 feet above sea in the lowest part at Torphins, to 1100 feet on the summit of Craigenget (Hill of Learney), and 1500 feet on the Hill of Fare, whilst the woodlands run from about 500 feet above sea near Torphins to 1080 feet on Craigenget, and to 1110 feet on the Tillenturk shoulder of the Hill of Fare.

The average height of the woodland may be taken as about 800 feet above sea, whilst there are ample examples of exposure to all points of the compass, seeing that the Hill of Learney forms a part of the main watershed betwixt the valleys of Dee and Don. The soil, which in many parts form a very thin covering on the underlying granitic rocks, has frequently a light porous gravel subsoil, occasionally traversed by layers of "pan," and in some few parts replaced by clay and peaty formations.

With exception of the 45 acres or thereby of old home-wood, which was planted at a considerably earlier date, the first large plantations, consisting principally of larch, were made between 1806-1825; and up to 1831 little thinning and no clean cutting seems to have taken place. During the following period of 13 years, up to 1844, thinning was carried on, but not to any very great extent, and from 1844 down to the present time, thinning, clean cutting, planting, and replanting have been carried on, as shown by the annexed plan and schedule.


LEARNEY ESTATE PLANTATIONS.
Tomnagorn
1000
500
0
1000
2000 yards.
Torphins
450'
Note:-Plantations over 20 Years old coloured
Do. under Do. Do
F. N. INNES,
September, 1906.
McFarlane & Erskine Lith Edin'

In 1844 there were 1420 acres of standing wood on the estate, and from that date to 1905, say in the last sixty years, there have been 1370 of these acres cut, leaving thus only 50 acres of old home-wood now standing. Of the ground so cleared, 661 acres have been replanted, and 169 acres of new ground have in addition been planted, which thus accounts for the total of 880 acres of wood at present standing on the estate. A considerable additional area of former woodland has been prepared, and is now ready for immediate replanting, whilst another area of about 100 acres where beetle is prevalent is to be pastured by sheep for a few years before replanting is carried out on it.

The actual financial return obtained during the sixty years from the 1370 acres of woodland cleared may be summarised as follows :—

Cut and used for estate purposes, . .	£1,953
Thinnings and blown trees sold, . .	9,666
Final clean cut sold, ...	61,852
Gross sum realised, . . .	£73,471

The average sums realised per acre were, approximately :—

Estate purposes and thinnings, etc., . .	£ 8½
Final clean cut, ...	45
Gross Average Return per acre, .	£53½

Of the 1370 acres which were cut, about 500 acres carried a pure larch crop, about 100 acres carried pure Scots pine crop, and the remainder mixed larch and Scots pine in varying proportions, with a proportion of spruce in certain suitable places. The average number of trees left standing per acre, when the time for final clean cut arrived, was about 225 trees, which would thus stand at about 14 feet apart. This result is arrived at without making any deduction for shooting rides, woodland tracks, etc., which would have slightly raised the average number of trees per acre.

It is difficult to estimate an average of size and price for the mature trees all over the ground, as these vary so much with the soil, elevation, exposure, and age at cutting; but the size

may be assumed all over at about 7½ cubic feet, with fivepence for pine and sevenpence half-penny for larch per cube foot as the general prices obtained.

In reviewing the results and financial returns, and in comparing them with similar statistics from other localities, the following points must be kept well in view in order to arrive at any correct judgment:—

1. The soil, elevation and exposure.
2. The age and species of the trees.
3. The mode of disposal in the market.
4. The facilities for transport on removal.

With regard to these points, in connection with the Estate of Learney, the following observations may be made:—

1. The soil and elevation have been already described, but it should be added that the hill is to a great extent isolated and exposed to gales of wind from S.W. and N.W., which have on several occasions made great havoc amongst the trees, and thus both lowered the financial return per acre by the small price obtained for blown and broken trees in a glutted market, and lowered the average number of mature trees standing on the ground per acre when the time for clean cutting arrived.

2. On a large extent of the ground the trees were allowed to grow for eighty years before clean cutting, as they required fully that time to arrive at maturity on the higher elevations; whilst on other parts of the area the glutted markets, following the severe gales experienced in 1893 and 1894, delayed sales for several years. The trees, however, and especially the larch on the northern slopes, have provided hard, close-grained, sound timber, samples of which, well over eighty years of age, may be seen in the Forestry Department of the University of Edinburgh.

3. The trees were, as a rule, sold by means of advertisement followed by offers taken in the open market, and have been purchased by many timber merchants well known in Scotland, and a fair market price has thus been secured. There is no local industry in the immediate neighbourhood, such as coal-mines or barrel factories, which can afford a steady demand for thinnings and thus augment the financial return.

4. In the earlier portion of the century under review facilities for removal were practically non-existent, except in the form of horse and cart. The woods lie twenty miles from the county town of Aberdeen, and six or seven miles from the river Dee, on the waters of which flotation by rafts was employed for the forests in the vicinity of that river. Railway communication was only brought to Torphins in 1861, and the average distance of the woods from Torphins Railway Station is about four miles by road, whilst about one mile is frequently over rough tracks on a rugged hill-side. The lowering effect on prices obtained for trees, owing to difficulties of transport and distance from a railway station, is too well known to call for further notice here.

The cost of planting and replanting the 830 acres since 1844 amounted to £1955, being an average of £2, 7s. per acre, and the schedule on the annexed plan gives the details, exclusive of fencing and draining, neither of which have been heavy items, as the ground is generally dry, and rabbits have been well kept down. The cost of planting, as of most other such work, has greatly risen in recent years, whilst the results in growth are perhaps not quite so sure and satisfactory as in former times; plants seem to be less hardy and more subject to the attacks of the many varieties of insect pests, which are much described and much depicted in books and in pamphlets, but against whose depredations it is hard to find any practical remedy within the limits of reasonable economy. Some interesting comparisons as to the success of diverse methods with this end in view, by varying the interval of time between cutting and replanting, by change of crop, and by clearance and preparation of the surface, may be arrived at from the particulars given in the annexed plan and schedule.

Prevention of the formerly unknown ravages of ground game and squirrels demands much time and attention, and the necessary clearance of the ground from brushwood before replanting, after felling the previous crop, is now a troublesome and expensive operation. As farmers and others are not nearly so ready as formerly to remove the brushwood, although granted free, collecting in heaps and burning has now to be resorted to, which sometimes costs about as much as the ordinary price of replanting. This apathy on the part of farmers is apparently owing partly to labour difficulties, and partly to the fact

that in many houses the grates are now adapted for coal, whilst the open hearths, where brushwood burnt easily, are disappearing. The peeled bark of larch, formerly used for tanning, is now left lying on the ground, although fit for good firewood.

The various systems adopted with reference to age and species of plants, number per acre, arrangement of mixed plantations in parallel strips, each strip consisting of a suitable number of adjacent rows of the same species, "pitting" and "notching" in plants, as well as the preparation of the ground, and intervals of time between successive crops, are noted on the plan and schedule.

Particular attention may be directed to plantations numbered 16 and 21 in the plan, where examples of "pitting" and "notching" are given in the same plantation; to number 1, where complete "underplanting" with spruce, where the larch crop failed at sixteen years of age in a mixed plantation, has succeeded. The general system of planting in strips, wherein, with a mixed crop, the number of adjacent parallel rows of the species forming a strip varies from one to six, is well illustrated in the different plantations. It is evident that the system of planting a mixed crop in alternate parallel strips, where the ground is suitable for such, ensures simplicity in thinning, numeration, removal, and in filling up vacancies; and in view of the insect pests and diseases now prevalent, the adoption of mixed crops seems very advisable, both for isolation of disease, and on the well-known principles of not putting all the eggs in one basket.

Six rows of larch alternating with three rows of Scots pine or spruce, or say only three rows of larch on ground where its thinning seems doubtful, appears to be the most practical form of mixture.

"Scraping" or mattocking a thin layer off the surface about 6 inches square has been adopted in plantations numbered 13, 14, and 19, at an additional cost of about 7s. 6d. per acre, and has been found useful for establishing young plants amongst thick vegetation, but it is no satisfactory preventive of the beetle. As a tree crop is, or should be, a long-lived crop, Forestry requires a long time and great patience for the derivation of knowledge, both from routine practice and from special experiment.

Forestry transactions do not appear to have been regularly recorded and preserved in former years on many estates in this part of the country, and the record of such transactions during the last hundred years, on an average upland estate may therefore be of some use in the formation of a future working-plan, or in deciding as to whether it is more profitable to employ certain land for game, sheep, pasture, arable ground, with its attendant expensive building and other outlays yielding small returns, or to employ it for commercial woodland.

These problems have been often worked out in various forms, and with various results and recommendations; but obviously no general rule can apply, and the answer must in each case depend on the locality of the area under discussion, and the market-prices which can be assumed as reasonably probable for the produce.

In the light of the experience here submitted, the problem involving the comparison as a profitable enterprise of the employment of land in the north-east part of Scotland, for an arable farm, or for afforestation, may be presented in the following form:—

Let it be supposed that a fifty-acre area of light soil, with no special amenities, in north-east of Scotland, and about 800 feet above the sea-level, has been converted into an arable farm. The outlay required for such conversion would be dwelling-house £250, farm offices £500, improvement and fencing of fifty acres of ground, together with necessary road and water supply, say £750, being a total outlay of £1500. The yearly rent of the farm, at only 3 per cent. on the capital outlay, would be £45, or eighteen shillings per acre. If one-sixth, which is certainly no excessive estimate, be deducted for public burdens and management, there remains for the proprietor only a sum of fifteen shillings per acre as net annual revenue, representing $2\frac{1}{2}$ per cent. on his capital outlay, without allowing anything for the purchase price of the unimproved land.

Should the tenant, however, under a lease of some years' duration, as is not unfrequently the case, agree to provide free of charge the necessary excavations, carriage of material, and other assistance, then, of course, the landlord's capital outlay and the tenant's yearly money rent per acre will proportionately diminish, but this does not affect the general argument on the subject.

On the other hand, let it be supposed that a precisely similar locality has been afforested by plantation with 1500 larch and 1500 Scots pine per acre, at an outlay of £6 per acre, including the necessary preparation of ground and fencing. The trees will have reached maturity in sixty years,[1] with a standing crop of say 225 trees per acre, composed of about equal numbers of the two species planted, having an average cubic content of 7½ cubic feet, for which fivepence for pine and eightpence for larch might be obtained per cubic foot.

The annual expenditure per acre during the sixty years would be:—

	s.	d.
Interest at 3 per cent. on £6 capital outlay, .	3	7
Management, ...	3	0
Total annual expense per acre, . .	6	7

The receipts per acre during the sixty years before clean cutting would be as follows:—

Value of Thinnings sold, ...	£10
Rent of grass pasture during the final forty years, at 2s. per acre, ...	4
Total receipts, . . .	£14

This sum of £14 is equivalent to an average annual receipt per acre, spread over the whole sixty years, of 4s. 8d. Deducting this sum from the annual expenditure leaves an annual deficit of 1s. 11d. per acre during the sixty years.

To meet the sum of such deficits, after allowing interest at 3 per cent. on each whilst unpaid, will require a lump sum of about £17, payable at the end of the sixty years, and, deducting this amount from the £46 then receivable as the price of the mature trees, we find the proprietor left with a sum of £29, which represents the £6 of his initial capital outlay, together with £23 of accrued profit per acre.

This accrued profit may be regarded as equivalent to a yearly sum of 2s. 9d. received during the sixty years, with interest allowed

[1] Under ordinary conditions such a crop would probably be felled at the age of about eighty years.—HON. ED.

on each payment at 3 per cent., and has the effect of raising the yearly interest, already credited on the £6 of initial capital outlay per acre, from 3 per cent. to fully 5 per cent.

The proprietor of the arable farm will be indeed fortunate if, after the lapse of sixty years, he finds the capital value of his buildings well maintained; but meanwhile he has received only 2½ per cent. yearly interest on his outlay, which makes but a poor comparison with the smaller, but intact capital, and the 5 per cent. rate of interest connected with afforestation.

Regarding the nature of the locality selected for the foregoing comparison, it may of course be noted that an area could easily be found producing timber results almost equal to those indicated, but which, from shallow soil and rocky formation, it would be quite impossible to use as an arable farm. This only strengthens the case for afforestation.

The north-east of Scotland is one of its most important of our forest districts; and in looking round the country it is easy to see that, whilst many acres now devoted to game and sheep might profitably have been planted, many other acres have been planted which will practically never produce timber of any value. On the other hand, many poor acres have been turned into arable ground, and furnished with costly buildings, which might have been much more profitably employed for growing timber, and may probably ere long go out of arable cultivation, leaving ruinous buildings as a memorial of the prevailing ignorance of the possibilities of forestry.

The prospects of favourable results from judicious forestry in this country seem now good, and it is to be hoped that such an important industry, by which not only employment of labour but beauty and shelter are maintained on the land, will not be allowed to fail, through ignorance, indifference, or false economy, although it may perhaps demand at the outset more of faith and hope than almost any other branch of agriculture.

Number on Plan.	Acreage.	Date of Planting.	Trees Planted.		Cost per Acre of Planting.	Previous Crop.		Remarks.
			Per Acre.	Age.	£ s. d.	Nature.	Year Cut.	
1	79	1870	2420 Larch 2420 Scots Pine			S. Pine	1850	Alternate parallel rows. Larch died on moist ground. Spruce underplanted amongst S. Pine as substitute in 1886.
2	24	1835	Scots Pine					3356 S. Pine now sold and being cut.
3	18	1880	Larch Scots Pine					
4	14	1861	1210 Larch 3630 Scots Pine	2 yrs. S., 1 yr. Tr.	1 10 0	S. Pine	1854	Larch planted at East end. Many ancient "tumuli" on the ground. Plants partly choked by broom at E. end.
5	43	1860	1500 Larch 1500 Scots Pine	2 yrs S., 1 yr. Tr. 1 yr. S., 1 yr. Tr.	2 0 0	S. Pine	1850	N.W. corner damaged by game. Many ancient "tumuli." 3 rows Larch, 3 rows S. Pine.
6	19	1857	3630 Larch 1210 Scots Pine	2 yrs. S. 1 yr. S., 1 yr. Tr.	1 12 0	S. Pine Larch	1855	W. corner damaged by game.
7	24	1870	4000 Larch 800 Scots Pine		2 10 0			Upheld 3 years by contractor. 2 rows S. Pine, 10 rows Larch. Plants partly choked by broom and whin.
8	64	1898	4000 Larch 800 Scots Pine	2 yrs. S. 1 yr. S., 1 yr. Tr.	1 15 0	Larch	1870	S.W. corner damaged by game. 5 rows Larch, 1 row S. Pine. Larch disease prevalent.
9	64	1903	2000 Larch 1000 Scots Pine	1 yr. S., 1 yr. Tr. 2 yrs. S., 1 yr. Tr.	2 11 0	Larch	1898	Brushwood of previous crop burnt. Beetle damage. 6 rows Larch, 3 rows S. Pine.
10	52	1902	1500 Larch 1500 Scots Pine	1 yr. S., 1 yr. Tr. 1 yr. S., 1 yr. Tr.	2 5 0	Larch	1901	Brushwood of previous crop burnt. Beetle damage slight. 3 rows Larch, 3 rows S. Pine.
11	5	1901	2000 Larch 2000 Scots Pine	1 yr. S., 3 yrs. Tr. 2 yrs. S., 1 yr. Tr.	2 10 0	Larch	1898	Brushwood of previous crop burnt. No beetle damage. 3 rows Larch, 3 rows S. Pine.
12	45	1760	Mixed					Old Home Woods. Additions made at various dates.
13	36	1879	2000 Larch 2000 Scots Pine			Larch	1861	Deep heather on ground; surface mattocked. Many Larch failed at 15 years. Squirrel damage N. end; rare for Larch here. 3 rows Larch, 3 rows S. Pine.
14	40	1903	1500 Larch 1500 Scots Pine	1 yr. S., 1 yr. Tr. 2 yrs. S., 1 yr. Tr.	2 10 0	Larch	1898	Brushwood of previous crop burnt. Surface mattocked. S. Pine damaged by beetle. 3 rows Larch, 3 rows S. Pine.
15	18	1899	2000 Larch 2000 Scots Pine			Larch S. Pine	1894	Larch failed except at S. end. Partly damaged by game.

19	70	1905	1500 Larch 1500 Scots Pine	2 yrs. S. 2 yrs. S., 1 yr. Tr.	2 10 0	Larch	1900	Brushwood of previous crop burnt. Surface mattocked. Beetle now attacking S. Pine. 3 rows Larch, 3 rows S. Pine.
20	14	1867	2000 Larch 2000 Scots Pine			S. Pine	1856	Larch partly injured by game. Alternate rows.
21	18	1900	1500 Larch 1500 Scots Pine	2 yrs. S., 1 yr. Tr. 2 yrs. S., 1 yr. Tr.	2 0 0	Larch	1892	3 rows Larch, 3 rows S. Pine. S. part pitted. Brushwood removed. Some Birch and Douglas Fir added on S.W., but not thriving well.
22	25	1860	1500 Larch 1500 Scots Pine			S. Pine	1857	Alternate parallel rows.
23	25	1902	1500 Larch 1500 Scots Pine	1 yr. S., 1 yr. Tr. 1 yr. S., 1 yr. Tr.	2 5 0	S. Pine	1899	Brushwood of previous crop burnt. Damage by beetle, and slight by game. 3 rows Larch, 3 rows S. Pine.
24	13	1889	2420 Larch 2420 Scots Pine	1 yr. S., 1 yr. Tr. 1 yr. S., 1 yr. Tr.	1 15 0	Larch S. Pine	1856	Pan in subsoil. Many Larch failed in upper part of ground.
25	19	1900	1500 Larch 1500 Scots Pine	2 yrs. S., 1 yr. Tr. 2 yrs. S., 1 yr. Tr.	2 0 0	S. Pine	1854	3 rows Larch, 3 rows S. Pine. Plants thriving well except in low corner at N.E.
26	15	1887	3630 Larch 1210 Scots Pine	2 yrs. S. 1 yr. S., 1 yr. Tr.	1 12 0			3 rows Larch, 3 rows S. Pine. Larch mostly failed, owing to pan in subsoil, except at road edges. Gaps filled at N. end with S. Pine.
27	5	1887	Spruce			S. Pine	1897	Spruce underplanted amongst S. Pine 10 yrs. previous to cutting.
28	40	1867	2420 Larch 2420 Scots Pine					Alternate parallel rows. Larch mostly failed. Partly damaged by game.
29	18	1889	2420 Larch 2420 Scots Pine	1 yr. S., 1 yr. Tr. 1 yr. S., 1 yr. Tr.	1 15 0			Alternate parallel rows. 6 acres at N. side planted in 1900.
30	6	1845	Scots Pine					
31	11	1899	Mixed					Larch and S. Pine on hard ground. Alder and Spruce in damp, mossy places.
32	22	1856	Larch Scots Pine Spruce					Spruce not thriving.

Total Acreage.	330

21. Soil: its Origin and Nature.

By Professor JAMES GEIKIE, LL.D., D.C.L., F.R.S.

I.

It is matter of common knowledge that the so-called "solid rocks"—the bones or skeleton of the land—are to a great extent concealed under a covering of loose materials of various kinds. More especially is this the case in low-lying and gently-undulating countries, where hard rock may perhaps be seen only in river-cuttings, sea-cliffs or other natural exposures, or in artificial excavations. In mountainous regions, on the other hand, the bones of old Mother Earth are more commonly laid bare. Even in such tracts, however, the steeper hill-slopes and the bottoms of the valleys are often more or less overspread with incoherent materials—the living bed-rock appearing perhaps only in the dominant peaks, crests, ridges, and buttresses of the higher elevations, and in ravines and gorges at lower levels. All the unconsolidated materials referred to are known collectively as "soils" and "subsoils," and consist essentially of mineral ingredients, derived from the disintegration of the so-called "solid rocks." Such being the case, it is obvious that the character of subsoils and soils must vary with the nature of the rock or rocks from which they have been derived. Disintegrated sandstone, for example, must differ greatly from disintegrated granite. It does not follow, however, that the soil-cap yielded by any particular kind of rock, must necessarily always have the same character. Much depends on the configuration or shape of the ground, and much also on climatic conditions. This will be readily understood when we consider how subsoils and soils come to be formed.

Rocks are invariably traversed by cracks and other fissures or natural division-planes, and they are moreover all more or less porous. Certain grits and sandstones, for example, are so pervious that water soaks into them almost as readily as into a sponge. Other rocks are so fine-grained and compact that they are only permeated with the greatest difficulty. So slowly, indeed, does water invade the extremely minute pores and capillaries of clays and argillaceous rocks, that these rocks are usually described as "impermeable."

The mechanical action of rain and frost upon rocks is so very obvious that it hardly needs to be described. Everyone knows

how water which has found its way into the fissures of a rock tends to widen these when it freezes. Rock-surfaces exposed to such action naturally become fractured and shattered, as may be seen everywhere amongst our mountains, the slopes of which are so frequently mantled by frost-riven débris. When water freezes in the minute pores of rocks, it tends in like manner to force the grains and particles of the rock asunder, so that when thaw ensues the disintegrated material is ready to be removed—in other words, the rock crumbles. Although frost is the most conspicuous rock-destroyer in this country, it is by no means the only agent of destruction. Rocks expand superficially under the heat of the sun, and contract again when cooling supervenes. Such alternate expansion and contraction loosens the cohesion of the mineral constituents of rocks, and thus so far plays the same part as frost. But this particular action, it is needless to say, is most notable in regions where the diurnal range of temperature much exceeds that experienced in temperate latitudes.

The mechanical action of rain is not less obvious than that of frost. It washes rock-surfaces and removes disintegrated materials, and the same operation is performed by water derived from melting snow. Wind, also, to some considerable extent, tends to sweep away the grit and dust derived from crumbling rock-masses. In this country, however, rain and running water are undoubtedly the most active agents employed in removing disintegrated rock-materials from higher to lower levels. Slowly, or more rapidly, as the case may be, these eventually find their way into the natural drainage-system of a country. Much of the sediment carried by streams and rivers consists of the disintegrated rock-material washed by rain and melting snow from the surface of the land. Thus the mechanical action of rain cannot be considered without reference to that of streams and rivers. The latter, as we all know, are not mere carriers of sediment, but effective agents of erosion. By means of the sand, grit, and gravel which they sweep along, they grind the rocky surfaces over which they flow, and, at the same time, undermine their banks, and thus are ever deepening and widening their courses. Much of the sediment resulting from this ceaseless process of erosion eventually escapes to sea, but not a little is caught in lakes or lodged within valleys, where it forms our well-known alluvial plains and terraces.

Speaking in general terms, therefore, one may say that the demolition of rocks and the removal of their débris proceed most rapidly on steep slopes and along the natural drainage-lines of a country. On flat and gently-undulating ground the products of disintegration move so slowly that they tend to accumulate upon, or in the immediate vicinity of the rocks from which they come. On steeper declivities the rate of movement augments, while it attains a maximum in stream and river-courses. Everywhere, therefore, from the tops of our highest mountains, down to the sea-coast, disintegrated rock-material is moving, slowly or more rapidly, as the case may be.

Hitherto we have been considering the mechanical action of the superficial agents in the breaking-up of rocks and the removal of the materials. We may now glance at the chemical action which affects rocks, and greatly aids the mechanical action of the several agents referred to. Without going into detail, it may be said that rocks fall a more or less easy prey to the destructive energy of chemical changes, according as they consist of relatively soluble or insoluble ingredients. Rain-water always contains some proportion of carbon-dioxide and oxygen, derived partly from the atmosphere and partly from the vegetable soil through which it percolates. Charged with these re-agents, it is enabled to attack rocks of all kinds. Some of these, such as limestone, consist of materials which are readily soluble, and may thus be almost wholly removed in solution as bi-carbonates—only a meagre proportion of relatively insoluble matter being left behind. Other rocks again, such as quartzite, are composed of mineral matter which strongly resists the solvent action of rain, and owe their disintegration, therefore, almost entirely to the mechanical action of the superficial agents. Between these two extremes comes a very large series of rocks which are affected in various degrees by rain. Take granite as an example. This rock is composed of three minerals, namely, insoluble [1] quartz, and two silicates known as felspar and mica.

[1] Probably there is no mineral matter quite unaffected by water. Under sufficient pressure, and at a high temperature (conditions which must obtain at no very great depth in the earth's crust), even the most refractory minerals are attacked by water. But at the surface and at slight depths such a mineral as quartz is practically insoluble, while many other minerals are only dissolved with extreme difficulty. Many of these, however, although not directly soluble, are broken up chemically by rain-water, and transformed into soluble and relatively insoluble materials.

These silicates, acted upon by rain-water, are eventually decomposed and converted into certain soluble and insoluble compounds. The soluble matter, consisting of bi-carbonates, are leached out, while the insoluble compounds may remain behind in the decomposing rock, or be washed away by the mechanical action of the rain. Such chemical changes are not confined merely to the superficial portions of rocks, but take place at all depths to which water can percolate. Rocks may in this way become "rotted" for hundreds of feet below the surface of the ground.

Living plants play an important rôle in the disintegration of rocks. By means of the acids in their roots they dissolve out the mineral substances they require. Further, their roots enter the natural division-planes of rocks, and gradually wedge these asunder, and thus, by allowing freer percolation of water, they prepare the way for more rapid rock-disintegration. The reduction of rocks is likewise helped on in many places by the action of tunnelling and burrowing animals—by worms and moles, for example, and by different kinds of insects. All these not only take part in the process of soil-circulation, but are the means of introducing much organic matter, and hence they aid the chemical action of percolating water.

The rate at which disintegrated rock-material travels over the surface is determined not only by the form of the ground, but largely by the character of the climate. In regions practically devoid of any vegetable covering, as desert-tracts, loose materials may be removed from the steeper slopes as rapidly as they appear. In such countries mountains and hills, however rapidly their rocks may be crumbling down, are not mantled with sheets of disintegrated materials, but are kept bare by the wind, which sweeps everything away to the low grounds, which in time, therefore, become more or less concealed under accumulations of drifting sand. In Arctic regions, again, where vegetation is meagrely developed, rocks are broken up with astonishing rapidity, and the disintegrated débris, under the influence of alternate freezing and thawing, readily descend declivities—occasionally moving *en masse* down relatively gentle slopes. Under ordinary conditions such rapid transference of rock-materials is quite exceptional in temperate lands. Only amongst our mountains does anything of the kind become conspicuous—where, owing to the inclemency of the climate, and the steep

gradients of the ground, a continuous vegetable covering is often impossible.

The protective influence of forests and turf, and the destructive results which follow from their inconsiderate removal, have long been recognised. In forest-clad hill-regions the soil-cap is covered with a layer of decaying vegetable matter, derived from the forests themselves. In the case of very old forests, this vegetable layer may vary from a few inches to a foot or even more in thickness. As it consists of a matted mass of leaves, branches, and fallen trunks, it is not readily removed by rain—the latter becoming absorbed and finding its way down into the soil-cap and the underlying rocks. After circulating through these rocks for a longer or shorter distance, it is again discharged as springs of clear water. But should the forest be destroyed, the vegetable covering of the ground will soon begin to disappear—the waste resulting from its oxidation being no longer made good by the supply of fresh materials from above. In time, therefore, the bared soil-cap becomes subject to the mechanical action of rain, which is no longer entirely absorbed—much at once running off and carrying with it a burden of sediment. Thus the soil-cap becomes reduced, and may be even entirely swept away. Precisely the same kind of destruction attends the removal of old turf from steep slopes. No doubt, even in forests and turf-clad land, soil is gradually being removed from higher to lower levels; but the process is slow, and the loss is made good from the subsoil, while the latter grows at the expense of the underlying rocks. But when the protective vegetable covering is removed from a steep slope, soil and eventually subsoil must vanish—the disintegration of the rocks, however rapid it may be, cannot keep pace with the washing away at the surface.

[*Note.*—This article will be continued in our next issue.]

22. The Utilisation of the Nitrogen of the Air.

By ALEXANDER LAUDER, D.Sc., Honorary Consulting Chemist to the Society.

In a paper recently published in the *Transactions* of the Society (Vol. XIX. Part II. p. 245), Dr A. W. Borthwick gives a striking account of the progress which has been made in recent years in Germany, Belgium, and other continental countries in the application of artificial manures in forestry. The work described there can hardly be said to have passed much beyond the experimental stage, yet the results so far obtained certainly suggest that considerable use may be made in the future of artificial fertilisers in forestry. In this connection, therefore, I have thought that the recent attempts which have been made to utilise the nitrogen of the air for manurial purposes might be of sufficient general interest to justify a short description in the *Transactions*.

It is now a matter of common knowledge that nitrogen is a constituent of all plants, and that unless an adequate supply of this element is available, the production of healthy vegetation is impossible. This element, nitrogen, exists in large quantities in the air, of which it forms about four-fifths of its bulk. Comparatively few plants, however, are able to utilise the nitrogen of the air directly, but can only make use of it when it is in combination with certain other elements, as we have it in nitrates, and, in consequence, the enormous stores of nitrogen existing in the atmosphere are of little use directly for fertilising purposes. For the supply of nitrogen to plants, then, we are limited to such suitable compounds of nitrogen as exist already formed in nature, or to such as we can prepare artificially. At present we have three main sources of supply, viz.—(1) farm-yard manure and other forms of organic nitrogen; (2) sulphate of ammonia; (3) nitrate of soda. Of these, only the sulphate of ammonia, obtained in the distillation of coal for gas or coke, may be said to be prepared artificially. When we consider the enormous annual waste of nitrogen in sewage, as well as the inevitable loss of nitrogen which takes place in the preparation of farm-yard manure, we see that we are gradually using up our stock of nitrogen compounds suitable for manuring. The nitrate deposits at Chili are by no means inexhaustible, and, together with this steady diminution in our supply of

nitrogenous fertilisers, we have to consider also the fact that the demand in the future for these fertilisers will steadily increase.

Public attention was first directed to the possibility of a "nitrogen famine" by Sir William Crookes in his Presidential Address to the British Association at Bristol in 1898. Not only did he point out the danger, but he also pointed out what he considered to be the remedy—the utilisation of the nitrogen of the air by causing it to combine with oxygen under the influence of electricity. At first sight this seems a very obvious way out of the difficulty, but the peculiar properties of free nitrogen makes the problem of its utilisation by no means such a simple matter. The element nitrogen, as it exists in the air, is a very inert substance, that is, it is only with the greatest difficulty that we can get it to combine with other elements to form the compounds of nitrogen, which alone are valuable from the fertilising point of view.

The address of Sir William Crookes directed fresh public interest to the problem, which had long been a favourite one with chemists, and since 1898 reports have appeared from time to time announcing not only new methods of fixing the nitrogen of the air, but also that the methods have been a commercial success. With the possible exception of the methods to be considered in this article, these hopes have unfortunately not been realised, and we are still hardly in a position to say that the problem has been satisfactorily solved. Sir William Crookes pointed out that the essential condition for success was an abundant supply of electrical power at a sufficiently cheap rate, to be obtained probably by the utilisation of the water-power at present running to waste in many parts of the world.

About 1785 the famous English chemist Cavendish showed that if you pass electric sparks through air, combination takes place between the oxygen and nitrogen, with the ultimate formation, in the presence of water, of small quantities of nitric acid. The same effect is seen in nature during a thunderstorm, the rain-water after a thunderstorm always containing more nitrates than the average amount present. Unfortunately, the amount of nitric acid formed by passing electric sparks through air is very small, and the cost of the electric energy required has hitherto prevented any successful application of the method on an industrial scale. It is

believed, however, that within the last two years the problem has been successfully solved by two totally distinct methods. In the first of these, which has been worked out by two Norwegian scientists, Professor Birkeland of Christiania University and Mr S. A. M. Eyde, a Norwegian engineer, the reaction which has been made use of is the combination of the oxygen and nitrogen of the air under the influence of the electric spark, first discovered by Cavendish. Briefly the process consists in passing a current of air through a powerful electric arc flame of special construction, whereby combination between the oxygen and nitrogen takes place. The fumes of oxides of nitrogen, as the compounds formed are termed, are absorbed in towers filled with limestone and afterwards worked up into "Lime Nitrate," the name the product has received commercially. After many trials on a small scale, works for carrying out this process were erected at Notodden, in Norway, in May 1905, and so successful has the process been, that large extensions are now in progress, and it is expected that an installation of 30,000 horse-power will soon be in full operation. The annual output of the fully extended works is estimated at 20,000 tons. The basic calcium nitrate, or "lime nitrate," as it is called, contains about 13·2 per cent. of nitrogen, and can be obtained in the form of a fine dry powder which can be readily distributed by an ordinary sowing-machine. Precise details as to cost are not yet available, but it is expected that the new fertiliser will compete in price with nitrate of soda. Considering how essential the supply of electric energy at a low price is for the success of the process, it is perhaps inevitable that the works should have been started in some country like Norway, where cheap water-power is so abundant. So far as it has been tested, lime nitrate seems to be quite equal to Chili saltpetre as a fertiliser.

The second method is quite different in principle from the one described above, and has been patented by two German chemists, Drs Frank and Caro. Its starting-point is the well-known substance calcium carbide, now so largely employed for generating acetylene gas for lighting purposes. This substance is prepared by heating together in an electric furnace, to a high temperature, calcium carbonate, or chalk, and coke or some other convenient form of carbon. Nitrogen gas is next prepared by passing air through a cylinder containing metallic copper, heated up to a suitable temperature, whereby the oxygen of the

air is absorbed, the nitrogen passing on to a gasholder, where it is stored. By heating the calcium carbide in a current of nitrogen, combination takes place, and a compound of calcium, carbon, and nitrogen is formed (calcium cyanamide), which is placed on the market under the name of "lime nitrogen." Lime nitrogen is a black powder, not unlike basic slag in appearance, which generally smells slightly of acetylene. It is not directly a plant-food, but in the soil it is converted gradually into calcium carbonate, or chalk, and ammonia, the latter of which is absorbed by the soil, to be rapidly converted into a valuable plant-food. It is evident that in "lime nitrogen" we are dealing with a much more complicated substance than "lime nitrate," and that extensive trials will have to be made, in addition to those already carried out, before we can be certain of its value under varying conditions of soil and climate.

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23. The Accumulation of Nitrogen in Forest Soils.[1]

By ALEXANDER LAUDER, D.Sc.

In this paper M. Henry discusses the important problem of the nitrogen supply of forest soils. He shows that, notwithstanding the large amount of nitrogen stored up in the trees and removed from the land when the timber is felled, the amount of nitrogen in the soil not only does not diminish, but, on the contrary, gradually increases. Even under the least favourable conditions, as when trees are grown on sand-hills, a gradual formation of humus, and consequently a gradual storing up of nitrogen, takes place in the soil.

As an example he takes the case of the forest at d'Hourtin (Gironde), sown with the seed of the maritime pine about 1850, and now forming a fine pole-forest, the stems being from 30 to 40 inches in circumference. The soil consisted of nothing but sand-hills without a trace of vegetation, and contained no nitrogen. Analysis of the soil now shows that, exclusive of the surface layer of decaying vegetable matter which was carefully removed before the soil was sampled, it contains 1·33

[1] La Forêt Accumulatrice d'Azote, par M. E. Henry. (*Extrait du Bulletin mensuel des séances de la Société des sciences de Nancy.*)

per cent. of organic matter. This organic matter or humus contains about 1·5 per cent. of nitrogen, which means in an acre of soil of 6 inches depth, about 240 lbs. of nitrogen. This represents the accumulation due to fifty-six years' growth, exclusive of what has been lost, of what has been stored up in the trees, and of what is present in the surface layer of decaying vegetable matter. It must further be noted that the soil in question would, for a long time, have little or no absorptive or retentive power for soluble nitrogenous compounds such as ammonia or nitrates.

The power of soils to absorb and retain nitrogen is very varied, and depends on a great variety of circumstances, such as the fertility of the soil, the composition of the principal stock, of the vegetable soil-covering, mode of working, climate, abundance of micro-organisms, etc. In the case of an old forest on fertile soil, the rate of increase of nitrogen is much greater, and the example quoted above may fairly be taken to represent the minimum rate of increase.

M. Henry next considers in turn the various means by which the soil can gain and lose nitrogen, and shows that the main source of increase is undoubtedly the nitrogen of the atmosphere; how is this "fixed" and ultimately converted into a form suitable for plant-food? That leguminous, and, to a lesser extent, certain other plants, usually abundant in the undergrowth of a forest, can fix the nitrogen of the air by means of the bacteria on their roots is now well known. The growth of these plants, then, gradually increases the amount of nitrogenous matter in the soil.

In addition to this, however, the announcement made by M. Henry in 1897, that certain micro-organisms, working on the dead leaves of various trees (oak, beech, hornbeam, aspen, Austrian pine, etc.), especially in the presence of moisture, have also the power of fixing the free nitrogen of the air, is now confirmed, not only by the later results of M. Henry himself, but also by the independent investigations of H. Süchting in Germany and D. L. Montemartini in Italy.

It is thus seen that the leaves at their fall, in addition to returning to the soil all the mineral matter not fixed in the body of the tree, form a substratum each year for the life of the micro-organisms which play such an important part in the fertilisation of the soil.

24. Forests and Rainfall.[1]

1. In the Plains of Middle Latitudes, Forest Lowers the Level of the Phreatic Waters.

Till 1898, the year when Western Europe learned the unexpected results set forth by M. Ototzky in 1895 with regard to the forests which occupy the Black Lands (Tchernozem) of Russia, in the governments of Voronej, Kherson, and Saratov, it was believed that in countries of the plains, where the subterranean water stratum is absolutely stagnant and consequently there is no flow, the forest played, with regard to water stored in the cavities of the earth, the same part as it does in hilly and mountainous countries. It has long been known, and often stated, that forest under the latter conditions (that is, placed on slopes where rain-water would flow down if the soil were bare, and where the water that sinks in flows over an impermeable bed, more or less sloping) stops all flow, and consequently increases and prolongs the supply of the springs, while preventing rapid and violent floods.

Now, the numerous borings carried out on the southern border of the region called in Russia "Forest Steppe," have enabled Monsieur Ototzky to formulate the following conclusion:—

"From all the observations made in the forests of the steppes of Southern Russia, we draw this result—that *all physico-geographical conditions being equal, the level of phreatic*[2] *waters in the forests of the steppe belt is lower than in the adjacent steppe or in neighbouring open country*. . . . The depression of the level becomes more marked under old forests than under new plantations. Under the forest the water is found, in the season of vegetation, to be 4 or 5 metres lower than under the steppe or the fields. But if, in the whole of this region of Southern Russia, where the rains are small, and heat and evaporation considerable, forest vegetation lowers to such an extent the level of the phreatic waters, has it the same effect in the northern

[1] *Les Forêts et les Pluies*, par M. Henry, Professeur à l'école Nationale des Eaux et Forêts.

[2] The name given by Daubrée in his *Subterranean Waters* to the subterranean water nearest the surface—that which supplies the wells.

regions—in the neighbourhood of St Petersburg, for example—where the climate is colder and damper, and evaporation less?"

This is the point which Ototzky wished to verify in his campaign of 1897, and this is his conclusion:—"In spite of different physico-geographical and climatic conditions (subterranean waters being abundant and near the surface, and the climate cold and very damp, etc.), I met, in the forests of the northern belt of Russia, the same fact as in the steppes. *Everywhere in the forests I studied, the level of the subterranean waters is found lower than in the neighbouring open ground.*" It appears that this conclusion applies generally to the whole of Russia, on condition, of course, that the soil has the same mineralogical composition, and that its various layers are horizontal, this being the cause of the immobility of the subterranean waters. These results were so contrary to the prevailing ideas, that it was necessary to verify them, and to see if different climatic conditions, notably a much greater rainfall, would not modify and even reverse the results obtained in Russia.

On the 1st July 1899, Monsieur Daubrée, Director-General of Forests, consented, at M. Henry's request, to grant the Forest School a sum for research into the influence of forests on subterranean waters in the north-east of France, where the rainfall is about three times greater than it is in the governments of Voronej and Kherson. The forest of Mondon, near Lunéville (Meurthe-et-Moselle), was chosen for this investigation, because it realises sufficiently well the desired conditions. The observations, taken uninterruptedly from 4th May 1900 to 24th August 1902, during twenty-eight months, from eight pairs of borings made at random under the forest and in the bare lands adjoining, proved *that the level of the subterranean waters is, in all seasons, three decimetres at least lower under woods than outside them.* Thus in a climate where the rainfall is much greater than at St Petersburg (80 cm. of waterfall at Mondon, and only from 45 cm. to 50 cm. at St Petersburg), the remarkable evaporating power of the forest makes itself clearly felt by the lowering of the water-level in the soil.

At the same time, M. Tolsky was making observations in the forest of Parfino, near Staraia-Russa (government of Novgorod), where there is a School of Forestry. "In concluding," says the author, "this short account of our observations made regarding

the level of the phreatic waters during five months of summer and five months of winter, November 1901 to October 1902, one is obliged to conclude that *the level of subterranean water in standing forest is lower than in the ground from which it has been cleared, both in summer and in winter, and that the oscillations of level are less in the standing forest.*"

M. Ototzky, persistently continuing his researches on this important point, is at this moment publishing a work in Russian, entitled, *Subterranean Waters, their Origin, System and Distribution*, the second part of which, "Subterranean Waters and Forests, chiefly in the Plains of Middle Latitudes," has just appeared. And M. Ototzky has also taken observations by means of chains of wells in the pine forests of the Lande of Gascony.

Four plains regions in Europe, where the subterranean water *is absolutely stagnant and motionless*, have thus been examined, and seem to show the same characteristics, but too little has yet been done in this direction for anyone to be able to formulate a general law on the subject. In place of the series of borings, as adopted by the Russians, M. Henry suggests a simpler method by means of pairs of wells, the construction of which he then proceeds to explain.

In the tropics, where the evaporation from the earth is so much more marked, forests might not be found to have this influence on the level of the subterranean waters. The result of experiments carried on in different parts of the globe would throw much light on the relation between the evaporation from the soil, whether bare or cultivated, and the transpiration by forests.

2. The Air is Moister over Great Wooded Areas.

Of the whole rainfall, part is evaporated directly from the vegetation, another part is evaporated from the soil, a third flows away, a fourth lies in the surface-soil, reaching its maximum when the soil is saturated, a fifth is absorbed by the vegetation for its growth and transpiration, and the surplus *only* goes to feed the stratum of subterranean water. This surplus is less under woods, and therefore the amount of water absorbed in other ways must be proportionally greater. In plains, with which our investigations are concerned, there is no flow of

water, and therefore that may be eliminated for our present purpose. The fraction imbibed by the surface of the soil is the same in forests as in agricultural land; the fraction evaporated on or in the soil is less in forests; the fractions retained and evaporated by vegetation, and absorbed for its growth and transpiration, must consequently be greater. This is known to be the fact, and the difference between the amount of evaporation from crops and that from forest can even be measured.

There must, therefore, be *in the air over forests a much larger amount of watery vapour than over any other cultivated ground*, and this has been demonstrated to be actually the case, notably by the meteorologist Fautrat, who states, further, that this moisture is more pronounced over evergreen than over deciduous woods. It is very difficult to measure the transpiration from wooded areas. The only results that can be quoted are those of the Austrian, Dr Franz R. von Höhnel, who, in the course of observations continued from 1878 to 1880, ascertained that a hectare of beech forest, 115 years old, absorbed daily from 25,000 to 30,000 litres of water.

The theory of the dampness of the air over forests is further borne out by aerial meteorologists, amongst others by Renard, who asserts that when aeronauts pass over wooded land there is always a well-marked fall of the balloon. This fact has also been observed above the forest of Orleans by many military aeronauts.

3. Forest Increases Rainfall.

When a mass of damp, hot air strikes against this column of damp, cold air rising from woods, at least a part of its watery vapour is likely to condense into the form of mist or small rain, thus causing more rainfall over wooded areas than over bare or cultivated plains. This has been proved by experiments at Nancy and other parts of France, Germany, Russia, and even India. But the extent of the influence of the forest on the rainfall is, of course, difficult to measure. From what has been shown, it is obvious that forest, *when it has sufficient masses of water at its disposal*, works like an extremely powerful pump, bringing the water up from a depth where it had become useless to vegetation, and sending it back into the current of atmospheric circulation.

4. To what Extent does Forest Augment the Rainfall of a Region?

It is impossible to answer this question precisely, but at places where observations have been made, an augmentation of 8 to 15 per cent. in the annual rainfall has been found. The matter is one which has received considerable attention from those who are interested in reforestation; some of them declaring that forests have "*infinitely little*" influence on the rainfall of a district—others asserting with truth that forest is of great importance It promotes the fall of rain by increasing the weight of clouds with the watery vapour which it supplies; by chilling the atmosphere, and thus inducing condensation; and by squeezing passing clouds, and thus causing precipitation.

5. Forests Feed Springs.

In hilly and mountainous country, where springs exist and the subterranean waters are in motion, forest plays a very different part. It augments and prolongs the supply of springs that have a deep source, and dries up superficial springs. For this there are two reasons:—

1. In forests furnished with a proper layer of humus, all surface *flow of water is stopped by the leaves and roots on the ground*, even though the slope may be considerable. Thus, at the time of the melting of the winter snows, for instance, the water on a wooded mountain disappears in a different way from that on a bare or grassy one. On the bare mountain, on the occurrence of thaw, the snow, exposed freely to sun or to warm wind, melts quickly and runs down at once, having no time to sink into the ground. This is often the cause of great floods. On a wooded mountain the snow melts much more slowly, and even if there is not much obstruction in the way of dead leaves, the slowness of the thaw gives the water time to sink into the ground. And this ground, which is always enriched by decomposed leaves and mould, acts like a sponge. It can absorb water up to four or five times its own weight; the soil immediately beneath it is also very absorbent, and the roots, while obstructing flow, do not drink up much moisture in winter. The water thus sinks *slowly* into the ground, and finds its way to impermeable strata of rock, from which springs rise.

2. Wooded mountains have also an influence, much more important than that of bare mountains, on atmospheric precipitation, through their action in damping and chilling the layers of air which arise from them. The extreme dryness of Spain, for example, in June, July, and August, is due to the fact that, though damp winds blow over it from the Atlantic, *the mountains against which they strike, being bare for the most part, are heated by the sun, and the wind, instead of being chilled by contact with them, is warmed.* This is noticeable in the provinces of Grenada, Jaen, and Murcie, in spite of their proximity to the sea and the absence of more western chains of mountains which might intercept the damp winds. When rain does fall on the Sierra Nevada and the Sierra de Segura, disastrous floods are frequently the result, the ground being bare and calcined, and presenting no obstacle to the downrush of the water. The winds in the south of Europe blow generally from the west in summer, but for want of a refrigerator, such as plain or mountain woods, they do not get chilled and condensed. The rainfall is generally determined by accidents of relief; and, notably in Spain and Algeria, the wind which comes directly from the sea has a temperature much lower than that from the land, and becomes warmer, not colder, as it reaches the high plateaux. There is only one method of *compelling* these winds to cool and condense into rain, and this method, an *infallible* one if foresters and aeronauts are to be believed, is *forestation.* All circumstances being equal, *wooded mountains induce more abundant precipitation than bare mountains.* But so far no conclusive experiments have been made except with forests of the plains.

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25. Arboricultural Notes from Portuguese East Africa.

(With Two Plates.)

By J. A. ALEXANDER.

Before starting upon a general description of this part of Africa and its sylvan landscape, it may be necessary to fix its geographical position. The whole territory to be described extends from the Zambesi river to Lourenço Marques, a distance along the coast-line of 633 miles. The first part is the territory of the Companhia De Mocambique—known as the Province of Manica and Sofala—which I am immediately connected with. The head station is Beira, built upon a sand-bank near the mouth of the Punge river, which drains most of the water-shed that the Beira Mashonaland railway passes through. Owing to its position, Beira is very healthy for an African coast town. It is 7570 miles from Southampton by usual steam-ship routes, and seven days' railway travelling from Cape Town by mail train, over 2000 miles across South Africa.

In this paper I shall only deal with the coast-line of a 20-mile belt in width, and the numerous islands that are situated on the coast, often near the mouths of the perennial rivers that fall into the Indian Ocean.

The Province of Manica and Sofala extends from the Zambesi river to the 22nd degree line. Being low-lying ground, the high tidal wave passes over it for some miles inland, and up the rivers for 30 miles. The forest cover is chiefly mangrove bushes within the tide-line—consisting of *Rhizophora mucronata*, *Rhizophora sp.*, *Ceriops Candolliana*, *Brugueira cylindrica*, and *B. gymnorhiza*. The last is known as the red mangrove. It is a very heavy, hard wood, resisting the attacks of the white ants (*Termites*), and it is much sought after for house-building purposes. It is peculiar in its habit, not being often found with other trees, and always in gregarious patches. It often grows to a good size and height, and is found farther inland than any other tree of this genus. When the Portuguese first came to this coast, in the beginning of the fifteenth century, they used this tree for all their forts and buildings. No stone could be found, and they brought what they required from Portugal, no easy task, as it had to be carried round nearly three-fourths of

Africa. *Cassipourea verticillata* is another common shrub. A good trade is done with the south of Europe ports in mangrove bark, but the unsystematic way in which it is handled cannot leave much margin of profit. I have seen it sent away in gunny bags—no attempt being made to reduce the cost of freight by baling. The mangrove bark is a poor tanning substance, producing a yellow dye. It contains too much of a pigment for leather preserving. I have often wondered why foresters at home waste so much time and trouble in laying out the oak-bark in fine leaves, when it has all to be reduced to a powder in the first process of manipulation. As a cinchona planter, I did the same thing, until I visited a quinine factory and saw the bark reduced to dust. From that date I spoke-shaved the bark off my cinchona trees, getting the same results at half the cost, and, best of all, I saved my trees. The Indian Government are very wise to still go on producing quinine from the cinchona tree. The chemist came in with his production, and killed out the sound, wholesome fever reliever of the planter. But what is the quinine the public are now served with? A poisonous chemical extract, with little of the properties of the genuine article.

The cover of the islands consists mostly of the trees and bushes mentioned. Near native huts there are cocoanut palms (*Cocos nucifera*); and they have also the cashewnut (*Anacardium occidentale*, L.) and mango (*Mangifera indica*, L.), both of which were introduced from India by the trading Mohammedans about the same time that the Portuguese first visited this coast. It is only within the last few years, however, that the cocoanut palm has come to be extensively cultivated, and at a few places only are old trees to be found. The history and value of this tree would alone occupy a long article. The cashewnut is a favourite tree with the Kaffirs. From the fruit they obtain a highly intoxicating spirit, and while that is in season (from October to December) they do not want work, for men, women, and children live in a state of intoxication.

The great characteristic tree of the region, which can be seen from some distance from land, and always on the highest points, with an ugly blunt head and branches, and for nine months of the year leafless, is the baobab (*Adansonia digitata*). Many of these trees can be found 80 feet in girth. Its wood is soft and spongy, but the acid matter surrounding the seeds, which are

contained in a shell the size of an ordinary orange, produces a pleasant cooling drink. From the inner bark, fine fibre can be made, which the natives turn to use in the making of fishing-lines and fishing-nets, which they tan with mangrove bark. Another tree which attracts strangers by its long racemes of flowers and cylindrical fruits is *Kigelia pinnata* (D. C.), but it has no commercial value.

Acacias are represented by *Acacia arabica*, *A. Kraussiana*, *A. caffra*, *A. horrida*, and *A. pinnata*. The wood of all is exceedingly hard and very durable, but owing to their very thorny nature, and the difficulty in getting them cut down, they are not so often turned to useful account as they should be. The Palmyra palm (*Borassus flabelliformis*, L.), the "Palmeira brava" of the Portuguese, stands out in his solitary grandeur. This palm is cultivated on the Zanzibar coast, and also in India and Ceylon. It produces a commercial fibre from which brooms and brushes are manufactured.

The tamarind tree (*Tamarindus indica*) is one of the finest timber-trees of the East, and the seed-pods are of great value to the natives, but only a few trees are to be seen near the dwellings of the Indian traders.

Taking a general view of this territory from the Indian Ocean, it is separated on the north and west from British Central Africa (Rhodesia) by the high mountain ranges Gorongosa and Manica, over 9000 feet high. The lowlands are mostly open forest with rank grasses, the most common of which is *Phragmites communis* (Trin.), often 10 feet high. Much of the country has been rendered worthless by the annual fires that have swept it, but my representations are this year bearing fruit, and only lands that are required for cultivation are now allowed to be fired. Over this belt of lowland the number of species of timber-trees is limited, and, with the acacias already mentioned, we have one *Albizzia* (*A. fastigiata*). The heart-wood of this tree is heavy and durable, and the Kaffirs never cut it down, for they have discovered its value as a shade-tree, and cultivation is successful under all the species of *Albizzia*. In many countries they are planted as shade-trees, for the light feathery foliage gives the necessary shade, and the small leaves shed over the plantation form excellent manure.

As a forest product, I must mention the valuable creeper, *Cocculus villosus* (D. C.). When searching for basket material

(not having bamboos within the dry zone), I made a trial of this creeper for basket-work with satisfactory results, and all our agricultural and cotton gathering baskets are now made with it. The mid-rib of the leaf of one of our common dry-zone palms, *Phœnix reclinata* (L.), is used as the framework. The mid-rib of the leaf of this palm is also used for fishing-baskets, and for the framework of the fish-fences that are to be seen along the coast, as it withstands the effects of the salt-water for a few years.

Useful fibre plants which we have turned to account in making ropes are—*Hibiscus vitifolius*, *H. calycinus*, *H. cannabinus*, *H. gossypinus*, and *H. tiliaceus*.

One of our best timber-trees is *Zanthoxylum capense*, the "knob-thorn" of the natives, a tree with curious spines on the trunk and branches, which are used for pipe-bowls. The wood is used for farm purposes, and the fruit, which is pungent, and is called the wild "cardamon," is used medicinally, while the bark of the root is a native remedy for snake-bite. The white ironwood (*Toddalia lanceolata*, Lam.) is a useful wood, and is used in waggon work. The timber of the Cape chestnut (*Calodendron capense*, Thb.), a handsome tree when in flower, is also used for waggon work. The white pear (*Apodytes dimidiata*, E. M.) yields a good hard wood.

Zizyphus Jujuba (Lam.) and *Z. mucronata* (Willd.) are both very common. The fruit is eaten by the natives, and the root and leaves are used medicinally. The wood is very durable, and, owing to their thorny character, they are useful fence trees, and can be pruned into any form. *Rhus lævigata* (L.) and *R. longifolia* (Sond.) yield useful, hard, heavy wood. *Millettia caffra* (Meisw.) is a small-sized tree, producing abundant handsome flowers. From this tree, the heart-wood of which is almost black, the natives make their walking-sticks and knob-kerries. *Dalbergia multijuga* (E. M.) and *D. melanoxylon* (Guill.) both yield hard useful wood, but they do not grow to a large size, and cannot compare with the Indian species. *Dalbergia Sissoo* (Roxb.) and *Pygeum africanum* (Hook.), the latter a large tree, not uncommon in Africa, produce good, useful timber. *Combretum truncatum* (Welw.), one of the largest and finest timber-trees in Africa, yields an exceedingly hard and heavy wood. *Eugenia capensis* (Harv.), *E. cordata* (Laws.), and *E. sp.* are all useful woods for house-building purposes.

A plant belonging to the cucumber family must be included as forest-produce. This is *Telfaria pedata* (Hook.), a gigantic tree climber, with a large gourd-like fruit, often 60 lbs. in weight, and which contains from 200 to 300 seeds which are rich in oil, and form an article of export to Europe. The natives boil and eat the seeds. *Gardenia Thunbergii* (L.) is a small-sized tree, with large, white, sweet-scented flowers. The wood is very hard and tough, and is used for many purposes. Another forest product found in abundance in some parts is a variety of coffee (*Coffea arabica*), with small, numerous, and rather astringent berries. It is the chief coffee used by the Portuguese and natives.

Myrsine melanophleos (R. B.), an erect tree, common in South Africa, produces excellent and useful timber. *Minusops caffra* and *M. obovata* (Sond.), "Milkwood," are both useful woods, and are used in buildings and carriage work. *Schrebera alata* (Wel.), a moderate sized tree, produces very hard wood and a profusion of fragrant flowers. *Olea verrucosa* (Link.), a not uncommon tree, produces heavy, strong wood, which is used for teeth of mill-wheels, etc. *Olea faveolata* (E. M.) and *O. laurifolia* are both useful woods.

Dobera Roxburghii (Planch.) is a large soft-wooded tree found about mangrove swamps, the timber of which is used for making canoes. *Strychnos Atherstonei* (Harv.) is one of the first-class woods of South Africa, and is used for staves, etc. There are many other species of this genus, some of which produce edible orange-shaped fruits, but their timber is inferior. In the natural family *Hæmodoraceæ* are some interesting commercial plants. Of the Sansevieras, which comprise twelve species in Africa and tropical Asia, two species, *Sanseviera guineensis* and *S. cylindrica* (Bojst) are plentiful on the coast. The fibre from the stalks of these plants is of a very fine silky nature, commanding in the European markets the high price of £30 per ton. The natives in the East produce beautiful mats and cordage from the fibre. These plants occur on stony places in the open forests and on old ant-hills, where they luxuriate, producing strong growths.

Of charcoal woods we have the following:—*Bridelia micrantha*. (Planch.), *Trema bracteolata* (Bl.), *Grewia caffra* (Mei.), *Sapindus capensis* (Hook.), and many others.

Not uncommon is *Trachylobium Hornemannianum* (Hayne),

the gum copal tree of the east coast. *Bowkeria sp.* is a common tree. It is used for canoes, and the ash is very white, containing a large proportion of potash. Some of the common large trees are *Ficus capensis* (Thb.), *F. cordata* (Thb.), *F. Vogelii* (Mig.), and *F. asperrima* (Roxb.). They are used for canoes.

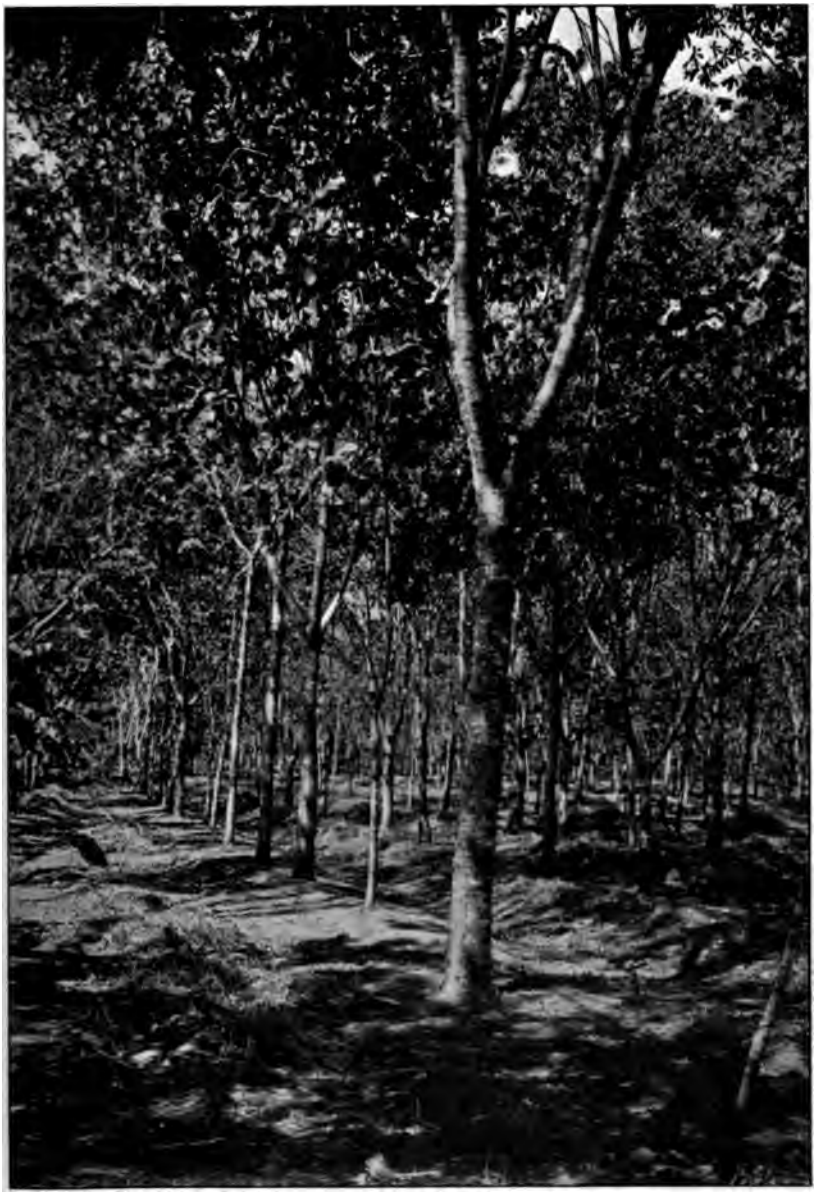
In passing, I may mention that the country is rich in pasture grasses, there being over fifty species on the coast belt, and large herds of cattle are now to be seen. Fever and tsetse fly are unknown.

In the Inhambane and Delagoa Bay districts, the land rises almost from the sea, so that it is only at a few points, and on the river banks for some distance, that mangrove swamps can be formed. The cover is mostly low, thorny scrub, consisting of *Acacia, Capparis, Zizyphus, Vitis, Abrus, Cassia, Carissa, Ipomœa,* and some of the coarse grasses. As seen from the sea, the Inhambane neighbourhood, with its beautiful land-locked bay, is almost an entire grove of cocoanut palms. No forest cover nor timber-trees are to seen. Palms and cashewnut trees cover the country for many miles inland. Only in the far interior, commencing at sixty miles inland, do clumps of forest appear; but to give a description of that area is outside the limits of this paper. The country is very populous, and the chief industry is in connection with the produce of the cocoanut palm.

Excepting by some of the river valleys, and near the Transvaal border, the district of Lourenço Marques has a very poor forest cover. The British Government made a serious mistake in not acquiring this port when the Portuguese wished to part with it for £12,000, not long after the award of Marshal MacMahon, in 1872. A fancy price would now be asked for it. Lourenço Marques is the best natural harbour in South Africa, and is fast becoming the most important port, being the proper outlet for the Transvaal. For lack of protection and conservation, there is little remarkable to relate regarding timber-trees and forest produce along this coast-line. Protection is only now coming into force. In the adjoining British colonies, afforestation is fast progressing, the Governments having come to understand that until there is forest cover to protect the crops and herds from pestilential winds, blights, and insect ravages, the bare mountain ranges and open plains are worthless for agricultural purposes. In this territory we have considerable forest cover,

and it only requires protection to become a valuable reserve.

In a subsequent paper I hope to deal with forest-trees and forest-produce—embracing the rising country and mountain ranges—in a more comprehensive way. With the exception of ornamental trees planted about the towns, very few exotic trees have been introduced. The *Casuarina* has become naturalised —the seed having been blown over from Zanzibar and Madagascar. It is an exceedingly durable wood, and being rich in carbon, is one of our very best charcoal woods. It is truly a marvellous tree, luxuriating as it does in Africa, Arabia, Egypt (on the banks of the Suez Canal), the dry plains of India, on the mountain ranges at 6000 feet elevation, in the West Indian Islands, the islands of the South Pacific Ocean, etc. It has travelled far from its native habitat—Queensland.



CEARA RUBBER TREES (*MANIHOT GLAZIONII*), SIX YEARS OLD,
IN THE BUZI VALLEY.

[*To face page* xxx.

FICUS INDICA IN AN AVENUE AT LOURENÇO MARQUES.

SAPINDUS SP. BEARING THE OIL-SEED OF COMMERCE.

26. A Session at the Eberswalde Forest Academy.

By A. F. WILSON, C.D.A.(Edin.).

Noting the attention which has recently been given to scientific forestry, I resolved, after finishing my agricultural classes at Edinburgh University, to pay a visit to Eberswalde, where I remained from the 1st April until nearly the end of August. My principal aim was to engage in practical forest work; but I also attended certain of the Academy classes under advice from Dr Schwappach, who suggested them to me in view of the extent of my previous studies. I had previously attended the Edinburgh University course in forestry, along with my agricultural classes, and I found it of great benefit in pursuing my further studies.

Eberswalde lies in the sand-plain of North-eastern Germany, and is within an hour's journey from Berlin. The district for miles around is naturally more or less flat, and the soil, as a rule, is poor, consisting principally of sand. The district under forest control comprises nearly 50,000 acres.

In giving this short sketch of my visit, I will deal mainly with the Scots pine, as it forms 75 per cent. of the woods round Eberswalde. The other 25 per cent. is chiefly composed of beech and oak, some of the young plantations being stocked with the red oak (*Quercus rubra*). Young plantations of Douglas fir are being extensively introduced, and the older plantations, the maximum age of which is 20 years, are thriving splendidly. Self-sown birch occur in considerable quantity, while alder are grown in the swamps.

When I arrived in the beginning of April, I found that the work in the forest and nursery was in full swing, so I had the opportunity of seeing the different kinds of work in progress.

THE FOREST NURSERY.

The nursery, which has been in existence for seventy years, is situated about a mile from the Academy, and is quite accessible to the students at all times. It is under the management of Professor Schwappach, who gave practical demonstrations to the students from time to time during the spring on the method of cultivating and manuring the nursery soil, and also on the sowing of seed and transplanting of plants.

The situation of the nursery is very good. It has a gentle north-easterly slope, and is well protected from various adverse influences by a Scots pine and beech wood about 120 years of age. It is enclosed by a high wooden fence, it is protected from rabbits by wire netting which runs along the outside of the fence, and is fixed half a foot below the surface of the ground as a protection against burrowing. Along the outside of the nursery are spruce trees 70 years old, and, owing to their dense evergreen crowns, they give assured protection. The enclosure, which is nearly an acre in extent, is cut into four main divisions by means of two paths crossing each other at a right angle. Each division is more or less subdivided.

Soil.—Through long years of careful cultivation, the soil is as near perfection as possible. It is a fine sandy loam, quite free from stones. It has received from time to time large dressings of leaf-mould, and every year it receives a dressing of basic slag and kainit. It is therefore in first-class condition.

Work.—Operations commence about the middle of March, the work consisting principally in the lifting and transporting of plants for use in the forest. When the nursery has been cleared of its growing stock, the greater part of which is 1-year-old seedling Scots pine, the ground is carefully trenched, the bottom spit being placed on the top; and as this sort of cultivation is carried on every year, the most thorough mixing of the soil takes place, and the beneficial effect of it is seen in the uniform size of the plants grown. When the trenching is finished the soil gets a top dressing of kainit and basic slag, and this is gently worked into the surface-soil. The ground is next laid out into beds. The breadth of the bed is 4 feet, and the length may be from 5 to 15 yards, according to the situation. A breadth of 4 feet has been found to answer best, as with this there is no difficulty in the way of weeding, the beds being thoroughly under control from both sides. Weeding paths one foot wide are left between the beds. After the beds have been marked off, the surface is gently trodden, and a special soil-mixing implement, consisting of an arrangement of discs, is used to pulverise the surface-soil. This is followed by a light hand-roller, which evens the surface of the bed and gives it a certain degree of firmness, and it is now ready for the drawing of the seed-drills, which are run cross-

ways for coniferous seeds, and generally lengthwise for large seeds. The drills which run cross-ways are made by a special drill marker, which is a very practical implement, and makes a very good finish. It can be adjusted to suit any width between the drills, and also to form large or small drills, according to the size of the seed. The drills are arranged in pairs, 2 inches apart, and half a foot between the pairs. Another and quicker method of drawing the drills is with the "markeur," an implement like a large rake, having usually four or five specially made teeth, with which the furrows for large seeds, such as oak, beech, and chestnut, are made. These drills are made parallel with the length of the bed, instead of across it, as is the case with the former implement. Another, and a very quick, method is by means of a roller. This is the same width as the bed, and has five V-shaped ridges upon its surface. It is drawn once backward and forward, the ridges forming the seed-drills. The two last-mentioned implements have long handles, and are pulled backward and forward by two workers—one at each side of the bed. I saw them at work in the nursery at Cloister Chorin, which is very much larger than the Eberswalde nursery.

When the seed-beds have been prepared, Scots pine and other seeds of a like size are sown either by means of the "seed-horn," a very quick though somewhat irregular method, or by means of the "sowing-stick." The latter gives greater uniformity in the sowing, and was used principally in the nursery garden at Eberswalde. This "sowing-stick" is made to suit the width of the bed. It has two sides fixed at a right angle to each other, the lower side being broader, and containing little grooves at regular intervals. Each groove holds about two seeds. The seed is contained in a long wooden trough, from which the "sowing-stick" is filled. To use it, two workers are required, one to hold each end of the stick. They dip it into the seed-box, from which it is filled, and they then lift it above the seed and give it a turn, when the surplus seed falls back into the box, only that contained in the grooves remaining. The charged stick is then placed over the drills in the seed-bed, and on being turned upside down the seed falls out. To me the method was quite novel, and it interested me very much. Although a costlier process than that by the seed-horn, by this method clumping is avoided when the plants come up, and

they are more uniform. After being sown, the seed is lightly covered, and the operation is completed by rolling the bed. Before being sown, the seeds receive a coating of red lead—1 lb. red lead to 10 lbs. seed—sufficient water being added to moisten the seed.

Transplanting.—The cultivation of the soil, and the size of the beds for the young transplants, is the same as has been already described for the reception of the seed. The method of transferring seedlings to the nursery lines in the Eberswalde nursery ensures the greatest success, if this is to be attained by careful planting. A worker places a board 4 feet long by 6 inches broad across the bed, and gives it a stamp in order to even and consolidate the surface. The soil is now dug away, about a spade deep, from the front of the plank. This plank is now replaced by another 7 inches broad instead of 6, the extra inch in breadth being notched for the reception of the plants. The distance between the notches is 6 inches, therefore the distance between the plants when planted is 6 inches by 6 inches. The plants are kept in boxes, and the worker places a plant in each notch. The worker sees that the roots are hanging naturally, and he then gently fills in the soil round about them. When properly covered, more earth is added, and well tramped round the roots. Soil is now thrown forward to level up the trench, and operations begin again for another row. When a bed is completed it looks exceedingly well, and the plants as a rule all thrive. All yearling coniferous seedlings, and also some broad-leaved species, are transplanted in this way. The work of transplanting is no sooner finished than weeding has to be commenced. The weeds consist mostly of chickweed and sow-thistles, and they grow quickly in the friable sandy loam. Once, during the summer, the young plants get a quantity of artificial manure in the form of sulphate of ammonia, $(NH_3)_2SO_4$, dissolved in water, the quantity being 20 grammes to 10 litres of water.

Replanting of the Felled Areas.

Transportation of the Plants from the Nursery.—The Scots pine seedlings are usually taken from the nursery for the regeneration of the felled areas at 1 year old. Very great care is taken in the handling of the young plants, in order to avoid

anything in the nature of abrasions to the roots or stems. They are lifted either by means of the spade, graip or fork, which is inserted deeply enough to ensure clean lifting. A spadeful of earth and plants is allowed to fall gently, so as to loosen the earth round the roots. This avoids the tearing of the tender rootlets, which is certain to happen when the earth is only loosened, and the plants pulled forcibly up. The young plants are then collected and put into rows of five blocks each, each block containing 1000 plants. The heeling-in is usually done in a shady part of the nursery. The rows are placed close together and covered with spruce branches for the preservation of moisture, and the plants are kept there until ready for transporting to the forest.

When plants are sent long distances, great attention is paid to the packing. Young plants are packed in hampers at the rate of 20,000 to 40,000 plants per hamper, the price for plants being 1s. per 1000 for 1-year-old seedlings, and 2s. 6d. per 1000 for 2-year-old seedlings. The plants are packed in layers, with their roots to the inside, and layers of moss—which reduces evaporation of moisture to a minimum—are placed between the layers of plants. The method of packing large plants, say 5-year-old beech, is rather interesting. Long wires are placed on the ground, some distance apart and parallel to each other. Long rye or wheat straw is next laid across the wires. Straw bands are then placed across the straw, and lastly a layer of damp moss. The plants are now laid on the moss, perpendicular to the wires and straw bands. There are generally 120 plants in each consignment, and they are packed in four bundles of 30 plants each. A layer of moss is placed between the bundles and over the roots. The straw bands are now tied round the plants, and then comes another layer of loose straw. The wires are first bound tightly round the bundle and fastened with pliers, and after being laced longitudinally the consignment is ready for rail. By experienced workmen the packing can be done in a very short time. The plants cost 5s. per 100, while the packing costs 10 per cent. more—that is 6d. per 100 plants. Large saplings are usually tied into convenient bundles, and merely have their roots protected. When small plants, such as 1- or 2-year-old Scots pine, arrive at the forest area which is to be planted, they are again carefully heeled into trenches and protected against the sun.

When required for planting, the plants are placed in boxes which usually have two compartments. To the partition in the middle of the box leather covers are attached, and these are used to cover the plants and protect them against drought while in the field. The roots are kept moist by being embedded in thin mud.

Cultivation of the Forest Area prior to planting.—In the Eberswalde district the soil and air are so dry, and the growth of grass (chiefly *Aira flexuosa*) and blaeberries so persistent, that natural regeneration of the Scots pine meets with no success, and artificial regeneration is wholly depended upon. This is done by sowing or planting in prepared strips, the percentage of the area regenerated by sowing being one-third as compared with two-thirds regenerated by planting. But where the soil is fresher, and carries a good crop of beech, natural regeneration under the small group system is doing very well.

The cultivation of the ground for Scots pine is usually done in strips about 1 foot wide, the width of the uncultivated strips between these being 3 feet. The turf may either be stripped by means of a plough, with a flat share and double mould-boards, or by means of the spade or broad hoe. The former method is quicker, but the sod is very irregularly taken off, with the result that the depth varies; and when there are many roots and stones present some other method must be adopted. In cultivating the strips with the spade, the sod is cut down both sides and also down the middle. This allows of about half a foot of inverted sod being placed on either side of the planting strip. The inverted sod on each side prevents the young plants from being smothered by the rank growth of grass, which always grows strongly for a year or two after the old crop has been removed, and it also hastens the decomposition of the underlying turf. A covering of grass, especially of *Aira flexuosa*, and moss is considered bad, as it usually dries the soil and produces dry-humus, which is of no use to the plants.

After the strips have been cleared, a man turns over a spadeful of earth at intervals of a foot and a half, and a worker follows with a wedge-shaped planting-spade, which he inserts into the turned over soil. This implement is pushed backwards and forwards so as to form a V-shaped incision. Another worker follows with a box containing the plants. Stooping, he uncovers the box; and taking a plant in his left hand, he proceeds to place it in

the incision formed by the planting-spade—holding it against one side, and seeing that the roots are arranged naturally. He then inserts his right hand into the notch and loosens the soil, which falls naturally round the roots. The operator now inserts the planting-spade into the ground a few inches back from the plant, and by first pulling the handle towards him, and then pushing it towards the plant, the soil round the roots is consolidated, and the slit is closed at the top. Professor Schwappach estimates the cost of planting an acre of Scots pine at from £2, 10s. to £7, according to the difficulties presented in the cultivation, etc.

Pit-planting is also largely practised, especially if the ground to be regenerated presents difficulties in the way of quick cultivation This is, however, not always the case. The size of the pits are about 1½ foot square, and the distance between the pits and the rows 4 feet. The cultivation of the pits was effected either by the spade alone, or by the broad hoe followed by a special soil-mixing implement. The turf is stripped off and inverted round the sides of the pit. The soil is then carefully turned over and mixed. The special mixing implement was rather interesting. It contained a number of blade-shaped prongs, each prong or tooth consisting of two parts, the flat of the top part being at right angles to the flat of the lower part. The implement is forced gradually into the soil by means of the foot, the handle being held by both hands. It is then pushed slowly backwards and forwards until the soil is thoroughly mixed. Two plants, generally 2 years old, are then planted, one in each corner of the pit.

In newly regenerated areas, if the grass is rank and threatens to overcome the young plants, the ground between the cultivated strips is mown with hooks in July.

The cost of labour in the Eberswalde district runs from 2s. 6d. to 3s. for men, and 1s. 6d. for women, per day.

Temporary Forest Nurseries.

In all large areas which are being regenerated, a temporary forest nursery is formed in order to provide a supply of plants to fill up the vacancies caused by failures among the young plants. The mortality is caused principally by frost, *Pissodes notatus* (stem), *Melalontha vulgaris* (roots), and *Hysterium* (young needles).

The selected area is cleared of all turf, weeds, stones, and old roots, and the soil is thoroughly mixed. Before anything further is done a fence of wire netting is constructed round the cleared area. The posts of the fence usually consist of Scots pine stems split down the centre. The stems used are those which have been more or less affected with *Trametes pini*, which produces a form of ring-shake. The wire netting is 3 feet wide, the mesh being small enough to keep out rabbits, and it is secured half a foot below the surface of the ground to prevent them from burrowing underneath. The posts are about 6 feet apart, and they stand 4 feet above the ground. A single wire, to which the netting is attached, is stapled to the top of the posts, and the cost of the completed fence is 4d. per yard. When the area has been fenced, the seed-drills are drawn, usually by means of the "markeur," as this is the quickest method. The seed is sown by the seed-horn, the drills are covered with the back of a rake, and the surface rolled. A part of the area is usually reserved for 1-year-old seedlings which are transplanted in the temporary forest nursery in order that they may become acclimatised before being planted out in spring to fill up the vacancies.

Insect Pests.

Like other forest areas, Eberswalde is not spared the infliction of insect pests, but the damage done by these is small compared with that inflicted by fungi, as the latter work havoc principally on old woods which are coming to their best.

Of the Coleopterous family, the pine weevil (*Hylobius abietis*) and the smaller pine weevil (*Pissodes notatus*) do considerable damage to the young Scots pine and other conifers by gnawing the stems of plants from 2 to 5 years old. Perhaps a greater enemy of young plants, both broad-leaved and coniferous, is the cockchafer beetle (*Melalontha vulgaris*), which does great damage in the grub stage by gnawing the roots. Remedial measures are seldom practised in the forest, as the results are so incomplete and the cost is so great; but in the nursery affected plants are pulled up and destroyed, while between the beds round pits with steep sides are dug, into which the beetles, when crawling about in the evening, fall and are collected and destroyed. Of the beetles which attack the older Scots

pine, the pine beetle (*Hylesinus piniperda*) causes the most damage. When the mature beetles appear in July and August, they fly to the crowns of the Scots pine, and bore into the young shoots, the leader-shoots generally being chosen. They mine towards the terminal bud, and after a gale of wind numerous shoots may be seen lying on the ground beneath the trees. When a leading shoot has been destroyed, a secondary one takes its place, resulting in a few years in a bent and twisted stem. The same result is also produced by crows and wood-pigeons alighting on and breaking the leading shoots.

Of Lepidopterous insects the worst is the Nun moth (*Liparis monacha*). The damage is done by the caterpillars, which feed upon the needles of the Scots pine, and to a less extent on those of the spruce. The attack may be so severe that nearly all the needles may be eaten through or devoured. The moths were exceedingly common in August, and it was quite a usual occurrence to find at least a dozen at rest on the bole of a tree. The Nun moth differs from the majority of insects in this order in taking two years instead of one to complete its life-cycle. Where forestry is practised on a large scale remedies are never tried, as the cost generally far exceeds the benefit derived. The Pine Shoot Tortrix moth (*Retinia buoliana*) gives rise to twisted stems through the caterpillars boring into the leading shoots, and thereby causing a lateral shoot to bend upwards to take the place of the attacked leader.

Larch is not grown to any extent at Eberswalde, as the soil is quite unsuited for it, and where it is to be seen, it does not present a very healthy appearance. In the month of June nearly all the younger trees were affected by the larch-mining moth (*Coleophora laricella*), the larvæ of which mine the needles, the tips of which become yellow. The remedy is to plant larch in suitable situations only.

Fungoid Diseases.

As I have already said, fungoid diseases are much more destructive here than insect pests. Perhaps the worst of all, at anyrate in the pine woods, is *Trametes pini*. This fungus attacks woods from 70 years old and upwards, and as the rotation for the pine is 120 years, serious damage is occasioned just before the woods are ready for the axe; hundreds of

pounds are lost every year through the damage caused by this fungus. The disease takes the form of a kind of ring-shake, caused by the mycelium spreading round an annual ring, and producing decomposition of the wood. The spores find an entrance through a wound, generally a broken branch. The only remedy is to cut out the affected trees, which are easily detected by the presence of the dark fructifications on the stems. The disease may spread fairly rapidly, as the old woods are only visited once every ten years for thinning purposes.

Another fungus of scarcely less importance is *Peridermium pini*. The mycelium of this fungus interferes with the circulation of the sap of the tree, the crowns become "dry-headed," the needles turn brown and fall off, and the tree ultimately dies. Small groups of trees all more or less affected were very noticeable, showing that the disease had been transmitted from the one to the other. The only remedy is to cut out all attacked trees, but when too heavy thinnings are not desired, trees which have only lost the needles of their under branches, and which show fairly healthy leaders, are left over till the next thinning. Until recently, it was the practice to leave the best trees of one rotation to stand over till the end of the following rotation, but it was found that these standards became "dry-headed" while surrounded by the young crop of the next rotation, and the practice has been discontinued.

Great damage is done to the young Scots pine by the needle-shedding fungus (*Hysterium pinastri*). It causes the needles to turn brownish-red and fall off. Plants up to six years old suffer most, and they usually succumb. Older trees of all ages may show signs of attack, but they usually manage to survive it.

Of the root fungi, the most destructive is *Trametes radiciperda*. This fungus only attacks the Scots pine on good soil (which was part of a glacial moraine). The heads of the attacked trees are more or less compressed looking, and the branches black in colour. They are to be felled in a clear-cutting this year, and the ground is to be replanted with red oak (*Quercus rubra*), the damper parts being stocked with the American white ash (*Fraxinus alba*).

Botanical Garden.

Of the many interesting departments in connection with the Forest Academy, not the least so is the Botanical Garden. It

is situated near the nursery, and contains a collection of the various species of European trees. The garden has been laid out in a meadow with an intervening sand-hill, and its longest side has a sluggish river for its boundary. The designing of the garden leaves little to be desired, and the place is very well kept. The paths are all bordered with conical-shaped hedges of spruce about two feet high. The garden is devoted almost solely to trees, but a number of ornamental shrubs are scattered throughout. The soil is practically of two kinds, the damp and water-logged soil of the flat, and the poor sandy soil of the higher ground. It can therefore be easily seen that a number of the species would be quite unsuited to the ground, if it were to be for anything other than demonstrative purposes. On the water's edge begin the willows, poplars and alders; then the ashes and spruces. On the drier ground are the planes, maples and oaks. The oaks showed how unsuited they were to the soil, as they were very unhealthy looking and covered with lichens. On the more rising ground are Silver Firs, Weymouth and Austrian pines, and a few unhealthy larch. On the higher portions of the garden the different varieties of the genus *Prunus* are grown. There are also plots demonstrating the various kinds of apple and pear trees. The beds containing the fruit-trees seemed to have obtained dressings of leaf-mould from time to time. All the trees are scientifically named on metal plates. A botanical lecture is held almost every week in the garden, where the different plants are dissected, and the means of recognising the different trees is also fully described and demonstrated.

Before closing this article, I may mention that the Academy contains museums in connection with the various sciences taught, and they are most "up to date." If a foreigner cannot at first follow the lectures clearly, he can at least profit immensely by a few visits to the places mentioned, particularly that which is set aside for the various implements in connection with forestry, and he will have the additional opportunity of seeing their use demonstrated in the field.

I hope this imperfect sketch may be the means of inducing others to take a course of forestry at Eberswalde; if they do, I can assure them that they will be received with the greatest kindness and consideration by the various professors whose classes they may attend.

27. Encouragement of Private Forestry.

By Professor SCHWAPPACH. (Translated by A. W. BORTHWICK, D.Sc.)

I have been asked to contribute an article to the *Transactions*, and in selecting a subject suitable to Scottish conditions I cannot do better than describe a case where the principle "help yourself" has been applied in German private forestry with the most satisfactory results.

Although German proprietors take much more interest in the welfare of their forests than English or Scottish proprietors, still the condition of the woods on small and medium-sized German estates leaves much to be desired, and the education of those in charge of the smaller forests is frequently very rudimentary and incomplete. Within the last eight years two important measures have been adopted to bring about an improvement. The one consists in the creation of a Forestry Department in the Boards of Agriculture, which is composed of specially trained forest experts; the other is the formation of the Society of Private Foresters of Germany. I will perhaps on another occasion deal with the result of the Forestry Department of the Board of Agriculture; at the present time I will describe the Society and its work.

In the spring of 1903 the Society was formed in Berlin. The editor of the *Deutschen Forstzeitung*, Herrn Neumann, of Neudamm, led the movement, and also bore the initial expense. To begin with, the Society was composed of foresters and a few gentlemen interested in forestry matters, but soon forest proprietors also recognised the importance of this Society, and became members, so that the work of the Society is now carried on by a very gratifying combination of forest proprietors and their foresters. The number of members at the present time is about 2200. Those foresters with an income not above 2000 marks per annum pay 3 marks; the rest pay 5 marks as a yearly subscription. Forest proprietors pay 100 marks on joining, and an annual subscription of at least 5 marks. The affairs of the Society are managed by a special and a general committee. The special committee consists of two foresters and a forest proprietor. The general committee consists of fifteen members, of whom six are foresters and six forest proprietors, the other three being extraordinary members (professors, experts).

An annual meeting is held in August, and at this time, as well as in February, a sitting of the general committee takes place.

In order to bring the members into more intimate touch with each other, and to represent local interests to the best advantage, branches of the Society have been formed, mostly according to provinces and confederated states. These branches hold meetings, and possess power to look after their own local interests.

The Society has, in the meantime, two important pieces of work on hand:—(1) improving the education of the under foresters, and (2) regulating the pension in the case of those unfit for work, together with other various kinds of business in connection with these undertakings.

The education of the under foresters in Germany at the present time is on the average unsatisfactory, and in many cases insufficient. Frequently gardeners and game-keepers are put in charge of forests, and at the best these men have received their initial training from other foresters. In order to improve matters, three measures have been adopted:—(1) holding examinations, (2) providing courses of instruction, and (3) the establishment of a special school. The examinations are held by Commissioners of the Society, and this gives those already in service an opportunity to demonstrate their ability and to obtain a certificate of efficiency. Such examinations were held in 1905 and 1906. In the first year there were 100, and in the second year 60 candidates from all parts of Germany, and for 1907 as yet 40 applications have been made.

The course of instruction is conducted by an expert, in the following manner:—Foresters, and also forest proprietors, assemble at some locality favourably situated to a suitable forest, where they remain a week. In the forenoons excursions are made in the forest to see and practise the most important operations, such as thinning and planting. In the afternoons a two hours' lecture is delivered, and this is followed by a discussion of questions bearing on the excursions, the lectures, or any other subject propounded by the members. It has, however, been found that this entails too much work and too great a strain on one teacher, hence in future two persons will share in the work of instruction.

These courses have met with great appreciation, and have served a very useful purpose. The most important service which the Society has rendered is the establishment of special schools

for the training of young people for private forest service, since there are otherwise no such institutions in Germany. The establishment of the school was made possible by the help of the town of Templin (Province Brandenburg, situated 90 kilometres north of Berlin), which possessed 3000 hectares of forest, and sold 1·5 hectares for the building and a large forest garden at the very low price of 100 marks, and guaranteed a loan of 80,000 marks at 1·8 per cent. interest, which loan is to be paid up at the rate of 1·5 per cent.; and, lastly, it placed the forest at the disposal of the Society for teaching purposes. Several other towns have taken an interest in the school and made similar endeavours. The school can accommodate forty pupils, and contains a dwelling for the director, an assistant and a caretaker. The cost of the building itself was 92,000 marks, and that of the necessary adjuncts (furnishings and fittings) 12,000 marks. With this sum it was possible to introduce all modern requirements, such as water-supply, electric light, and good teaching material. The total amount necessary, namely, 104,000 marks, was raised from the following sources:—To the 80,000 marks lent by the town were added 10,000 marks, the previously collected capital of the Society, and 14,000 marks were given by the forest proprietors and other members of the Society. The course lasts one year (1st July to 15th June). The pupils pay 424 marks, for which they receive board, lodging and instruction. The actual cost is naturally much higher, and runs to 700 marks per head. The deficit is made up out of the Society's means, the support of two Boards of Agriculture, and the current subscriptions of forest proprietors. The object of the instruction is purely practical, and value is attached to the fact that the pupils learn to do all kinds of forest work. The school was opened on the 1st October 1906, and has developed splendidly. According to my mind, it should be quite possible to establish a similar institution in Scotland.

The second important object of the Society at the present time is, as already stated, the establishment of pensions. The salary of an under forester is usually not very great, but he may be able to make ends meet as long as he is able to work. His case is, however, very different and unsatisfactory when, through age or illness, he becomes unfit for work. The proprietors of small and medium-sized forests cannot, and will not, guarantee a legal claim to a pension such as that guaranteed by the State

and Communities to their servants. The Insurance Societies demand such high annual premiums from an individual that he cannot pay them. The attempt has, therefore, been made to obtain more favourable conditions, either by the establishment of a special fund, or by the Society making terms with an Insurance Company. This is a very difficult question, and has taken years of consideration to obtain a very small insight into it. At present the matter stands thus, these two propositions exist, each of which in its own special way has pretty much the same object in view. By payment of 10 to 12 per cent. of the wages (according to age) it is expected that the forester would after ten years, provided he was incapacitated, be entitled to a pension equivalent to a percentage on his usual wages, commencing at 33 per cent. and rising gradually to 75 per cent. It is also expected that the forest proprietor will pay half of the premium, or more, provided he is satisfied that the forester is insured. It is to be hoped that this problem, which is very important for the great mass of private forest officers, will be brought to a satisfactory solution during the current year.

May these lines contribute towards the undertaking of similar operations by the Royal Scottish Arboricultural Society.

28. The Woods of Somerset.[1]

The publication of a further memoir of the Geographical Distribution of Vegetation in Britain adds to our exact knowledge of the nature and distribution of British woods, and is evidence that the work initiated by the late Mr Robert Smith is being vigorously prosecuted. The district dealt with in the memoir is divided into a lowland and an upland area. The former consists of recent deposits, and was primitively treeless; and even now plantations are uncommon there. The geology of the upland area is a matter of great complexity. It includes an almost unbroken sequence of strata from the Old Red Sandstone to the Chalk, and it might be inferred that the vegetation must be equally diverse. Such, however, is not the case. Vegetation responds to the substratum in which it grows, *i.e.*, to the soil; and while the soils of the upland area are singularly free from recent deposits, and bear a direct relation to the underlying rocks, yet those differences among rocks and resultant soils which are important to the geologist are not necessarily those which affect vegetation. From the standpoint of vegetation, it was found necessary to subdivide the soils of the upland area into only three classes,—sandstones, limestones, and deep marls and clays; and the vegetation is considered under these headings.

A characteristic of the soils of the sandstones is the readiness with which a coat of humus appears as a superficial layer, and which, when the ground is left to itself, in time develops a covering of peat. The ultimate plant association of the sandstones appears to be an oak wood; but most of the primitive woods of the district have been destroyed and converted into farmland, or have degenerated into heaths or moors. Oak woods are recorded as occurring on the Greensand, on the Coal-Measures, and on the Old Red and Devonian Sandstones. The oak wood region of the Greensand is roughly co-terminous with the limits of the ancient forest of Selwood, which originally covered about 20,000 acres. On many of the heaths, commons,

[1] *Geographical Distribution of Vegetation in Somerset: Bath and Bridgwater District*, by C. E. Moss, M.Sc. London: The Royal Geographical Society, 1 Savile Row; Edward Stanford, 12, 13, and 14 Long Acre, W.C. 1907. Price, to Fellows, 2s. 6d.; to non-Fellows, 5s.

old warrens, quarries and other waste places on the sandstones, copses of oak, birch and sallow spring up quite spontaneously.

There is not a natural beech wood of even moderate dimensions to be found in the district. Isolated trees and small clumps of beech occur here and there, and small belts and plantations are not uncommon.

The vegetation of the limestones is much more varied in character than that of the other rocks and soils of the district. The woods of the limestones are dominated by the common ash. Natural copses of ash and ash-associates are numerous, the larger of which possess many features in common with the ash woods. The ash woods occur on the slopes of limestone hills. Reference to the vegetation map which accompanies the paper will show how they fringe the summit cultivation on the Mendip Hills. Ash woods are found on the Carboniferous Limestone, on the Dolomitic Conglomerate, and on the Oolitic limestones around Bath. Some of the ash woods are partially a result of modern forestry; yet many appear to be truly primitive, and seem to be the scattered remnants of the historic forest of Mendip. The soil of the ash woods is a red marl, sometimes very shallow, stony and dry, and in such situations the ash occurs to the exclusion of every other arboreal species. Great stretches of dog's mercury and wood garlic are characteristic of the ground vegetation of the ash woods: bluebells and bracken are scarce; and *Holcus mollis* is quite unknown. The ash wood had been recognised, in a previous botanical survey of Yorkshire by Smith and Rankin, as a type of the vegetation of the Carboniferous Limestone of Yorkshire; and the occurrence of pure ash woods is also recorded on the same geological formation in Derbyshire. It would seem, therefore, that the ash wood is characteristic of limestone districts.

Oak-hazel woods are characteristic of the deep marls and clays, such as the New Red (Keuper) Marl, the Lias, the Bradford Clay, the Fuller's Earth and the Oxford Clay. The oak is the dominant tree, but in these woods it is not planted so thickly as in the oak woods of the sandstones. Shrubs, usually hazel, are planted among the oak standards, and the hazel-coppice is exploited. The tendency to replace hazel-coppice by high-forest is not observable in Somerset. Many of the oak-hazel woods are about a century and a half old; but others are more ancient, and possess many of the characteristics of

primitive woodland. As in the other woods of the district, game are reared and shot, and the woods are intersected by long straight drives. Conifers are often planted, sometimes as a protection along the border of the woods, sometimes as ornaments along the drives, and are often useful as landmarks. The ground flora resembles that of the more shady portions of the ash wood. The soil of the oak-hazel woods is very damp, and, as in the ash wood, is deficient in humus.

My observations show that the presence or absence of lime in the soil is not the determining factor in the distribution of the dominant tree; for whilst ash is dominant in the limestone woods, yet oak is dominant in the deep marls and clays, which are often highly calcareous; and, on the other hand, oak is dominant not only on highly calcareous marls, but also on the silicious soils of the district. The deep soil of the marls and clays and of the Greensand is favourable to the variety of oak with stalked acorns (*Quercus pedunculata*), whilst the usual form of oak met with on the shallow and rocky sandstone soils is the sessile-fruited oak (*Q. sessiliflora*).

Lichens are abundant on many of the trees of Somerset. In some cases, particularly on old birches, fruiting specimens of *Usnea barbata*, the tree-beard lichen, are excessively common, and other species are equally in evidence. Though lichens are not parasitic on the trees, yet their occurrence in excess hinders normal growth and development.

The introduction of conifers into the woods of Somerset is on a large scale. Pine and larch plantations are abundant, but there are no large spruce plantations. The larch can scarcely be regarded as a successful introduction, as, in every larch plantation examined, the larch canker (*Peziza Willkommii*) was found, and in some plantations the disease was very prevalent. Mixed plantations of larch, spruce, Scots pine and beech are common throughout the district, especially on the Mendip summits, at an altitude of about 1000 feet.

In small areas, it would appear that plant associations are determined more by edaphic or soil factors than by climatic conditions; but the soil factors cannot usually be inferred from a geological map merely. Of the edaphic factors, the occurrence of humus and humous acids is one which is highly important, and deserving of more attention than has yet been bestowed upon it.

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29. Notes on Indian Forestry in 1906.

By JOHN NISBET, D.Œc.

Probably for the first time in its history, the Indian Forest Department had a very high compliment paid to it in the Secretary of State's Budget speech in the House of Commons, when he stated, on 20th July 1906, that "there has been an increase in forest revenue in five years of more than £600,000. I cannot wonder that those who are concerned in these operations look forward with nothing short of exultation to the day when this country will realise what a splendid asset is now being built up in India in connection with these forests."

The net surplus revenue, after deducting all direct and indirect expenditure on the working, management and improvement of the 250,000 square miles of State Forests entrusted to the Forest Department (of which about 100,000 are reserved, and 150,000 protected or unclassed forests), amounted in 1903-04 to £670,000, but in 1904-05 it rose to £730,000, and in 1905-06 it was estimated at £840,000. And these large sums of net revenue, it must be remembered, would be very largely increased if any credit were given for the money-value of timber, bamboos and minor produce either removed free under grants and registered rights of user, or else sold to privileged parties at reduced rates for extraction. But large though this revenue be, there is still ample room for its expansion, as it only represents below £3 a square mile of forest, or $1\frac{1}{8}$d. an acre.

One is apt to get bewildered in the immensity of Indian figures and areas. They run so easily into millions of cubic feet of timber and of fuel, many millions of bamboos, hundreds of thousands of pounds sterling of revenue, and thousands of square miles. The 250,000 square miles of State Forests are administered by nineteen Conservators, so that each such circle contains over 12,500 square miles of reserved or unreserved forests, while the actual extent of territory forming each Conservator's charge averages over 57,000 square miles, which is over 3400 square miles in excess of the total area of England and Wales.

Two of the effects of the large surplus revenue earned for the Indian Treasury have been the reorganisation of the Forest Department and the improvement of the scale of pay to the officers. The last reorganisation took place in 1882, so that the improved position now given to forest officers has only been

somewhat tardily accorded. However, better late than never. As now reorganised, the sanctioned scale of appointments provides from 6th January 1906 for:—

		Rupees per Month.
1 Inspector-General,	on a salary of	2650
2 Chief Conservators (Burma and Central Provinces),	,,	2150
19 Conservators, 6 of I. Grade,	,,	1900
19 Conservators, 7 of II. ,,	,,	1700
19 Conservators, 6 of III. ,,	,,	1500
136 Deputy Conservators,	Commencing with a salary of Rs. 380 a month, rising by annual increments of Rs. 40 a month to Rs. 700; and after that by increments of Rs. 50 a month to Rs. 1250 in the twentieth year of service.	
72 Assistant Conservators,		
9 Foreign Service Appointments (4 temporary),		
1 Assistant Inspector-General,		
5 Officers at Imperial Forest College and Research Institute, Dehra Dún (who each draw in addition a special allowance of Rs. 150 a month),		

These are very substantial increases of salary, which remove a well-founded Departmental grievance of several years' standing, although the question of improved pension for the two lower grades of Conservator is still unsettled. But what had perhaps quite as much as the handsome revenue to do with obtaining this improvement in pay was the fact that the last year's competitive examination, advertised for nineteen vacancies, was a complete failure. For the first time since the institution of this system (in 1867) there was an almost total lack of candidates. So competition was abolished, and selection by an advisory committee took its place: and this gave the India Office food for thought. The very unnecessarily expensive three years' course of training at Oxford is still in vogue, and will remain so till 1909, but the Secretary of State is bound by a formal promise (made in his name in the House of Lords by the Under Secretary, the Marquis of Bath, in March 1905) to reconsider his orders about this in March 1908. After that it may perhaps be possible that desirable changes may be made for procuring suitable training for probationers at a much smaller cost of their time and money than at present. If it be possible, as actually is the case, to train Indian civil servants in a twelvemonth's time, and to obtain civil engineers, and educational and scientific officers ready to proceed at once to India, it should not be impossible to obtain fairly well-equipped foresters, now that forestry is taught at several universities and at most agricultural colleges.

This important question of the training of probationers for the

Indian Forest Service has, naturally, been attracting much attention among Indian forest officers, and especially since the issue of the Government Regulation of June 5, 1906, converting the Dehra Dún School into an Imperial Forest Research Institute and College (see Vol. XX. Part I. pp. 115-117). This institution, maintained since 1878 for the training of subordinate officers (rangers and foresters) for the various Provincial Services, has now been transformed into a place where technical instruction and scientific research are combined. The lectures are henceforth to be given entirely in English, the lower vernacular classes for foresters being thus abolished, and each of the six research officers is to give a course of lectures in his own special branch. This will not interfere with the research work, as the lecture session is confined to the four rainy months (July to October), when in any case all the officers will be at headquarters. This arrangement is a decided improvement. When I was deputy director and chief instructor at Dehra Dún in 1894, I had to lecture not only on Sylviculture, Management and Protection, and Utilisation of Produce, which were my own proper professional subjects, but had also (in the absence of the regular lecturer) to deliver a special course on Zoology, for which I felt myself little qualified.

For the vernacular teaching of the lower subordinates (foresters and forest guards) the various Local Governments are now making the necessary provision. The first of such purely local Forest Training Schools was that proposed and organised by me (1895-97) whilst Conservator in Burma, and the second that at Coimbatore for Southern India, organised by Mr Gass, Conservator of the Southern Circle, Madras.

The researches that can now be undertaken at the Research Institute and College will differ considerably from those questions with which the various European Experimental Stations are concerned, for the special problems requiring solution are of entirely different nature in the temperate and the tropical zones. And even in the different provinces of India (extending to over 1,000,000 square miles), the forest questions vary considerably in many respects. That this work will be undertaken enthusiastically is evident from the feeling of gratitude with which the Department has welcomed the Government Resolution:—

> The study of the injurious pests, both animal and vegetable, the chemistry of the widely varying soils and of the extremely numerous minor products of

the forests, and finally a knowledge of these minor products themselves, have been quite beyond the power of the heavily worked executive officer to grapple with. No one but the specialist, the Forest Officer who, having followed the ordinary educational course of his brother officers, has subsequently made a speciality of a particular branch of these forest sciences, can hope to obtain, after perhaps years of patient observation, investigation and experiments, such an acquaintance with his subject as to make his researches available from a practical and economic point of view to the Executive Officer. Owing to the recent enlightened action of the Government of India, the Department will now have four officers each devoting himself to one of these special branches, and we foresee in the near future, and it may be written without hesitation or fear that the conviction will be found unjustifiable, that such an advance will be made in our knowledge of these subjects, both in economic and scientific directions, as will justify to the hilt the action of Government and the previous convictions of the Department as to the necessity of the present departure.

We feel sure that we are but voicing the sentiments of the Service when we tender to the Government of India our sincere acknowledgments for one of the most important economic and scientific departures which has been made since the creation of the Forest Department, and we have every confidence that the results achieved will fully justify the far-seeing statesmanship which has inaugurated the new policy.

As regards the training of probationers, there are not wanting some who, with a solid foundation of common-sense, suggest that the special training of Indian Forest Officers can perhaps in future best be given at Dehra Dún; and there are many others who think that the late Coopers Hill and the present Oxford training neither was, nor is, what is wanted. These are, of course, as one can quite well understand, views which do not commend themselves to Dr Schlich, even although everyone may recognise the good work he has done for twenty years at Coopers Hill and is still engaged in at Oxford. But with the preparatory technical instruction (mainly in Continental forestry, or its direct offshoot) now obtainable at various university and collegiate centres, it should be easy to obtain men for the Indian and Colonial Forest Services by open competition in the four main branches of Forestry and the chief Cognate Sciences, and then give them one year's special and chiefly practical training.

A long tour (April to July) in Southern and Eastern France (Alpes Maritimes, Gascony and the Pyrenees, and the Vosges), in Wurtemberg and Baden (the Black Forest), in Bavaria (the Bavarian Alps and the forests on the plateaux and plains), and in Switzerland, these being the parts of Southern and Central Europe which are undoubtedly by far the most instructive to the Indian forester, might be followed by a three months' course of lectures

(August to October) on Indian Sylviculture, Protection, Working Plans and Utilisation, Indian Forest Law and Departmental Procedure (Forest Code and Accounts); then by the voyage to India in November, and a four months' tour (December to March) directed from the Imperial College at Dehra Dún, before the commencement of actual service with the official year (April 1).

But if any collegiate course is to be continued after 1909, at Oxford or at any other University centre, then the teaching of Indian vernacular languages seems just as desirable as in the case of the Indian civilians, who study chiefly at Oxford and Cambridge during their one year of probation.

What would perhaps be the most suitable training of all would be a system closely approximated to that given to the Indian Civil Service probationers—namely, after a collegiate course and an open competition in Forestry and the Cognate Sciences, a one-year's course of study at Oxford or Cambridge in Indian Forestry, Forest Law, and Departmental Procedure and Accounts, together with Hindustani and other vernacular languages, and one special branch of science (Botany, Zoology, Geology, or Soil-Chemistry) according to choice. This would save time and money, and make the disparity between Civil Service and Forest probationers less glaring than at present, when the Forestry course costs far more, although the pay and the pension in prospect are both far less than the Civilian is certain to obtain.

This subject is here adverted to at greater length than would otherwise have seemed proper, but the correspondence in the *Indian Forester* shows clearly that it is one of the burning questions of the day out there, the importance of which regarding the future progress of the Department it is impossible to ignore.

One of the most interesting and valuable of the papers published during the year is an official bulletin (No. 9) by Mr Eardley Wilmot, Inspector-General of Forests, concerning *The Influence of Forests on Water Supply*. Nowhere in the world is this question of greater moment than in large portions of our Indian Empire, where scanty rainfall and deficient water-storage capacity mean at least poor crops, and often severe famine affecting millions of human beings throughout all the regions where the rainfall is scanty and precarious. In the Government of India Resolution of October 1894, the Departmental policy formally adopted was that "*the sole object with*

which State forests are administered is the public benefit." Formal recognition was therein given to the necessity of "*protection from the devastating action of hill torrents of the cultivated plains which lie below them,*" but no allusion was made to the necessity of maintaining, so far as possible, a permanent water-supply in the soil. Thus soil-erosion was put prominently forward, while agricultural utility was not so definitely kept in view—although as early as 1846 Dr Gibson, then Government botanist in Bombay, had drawn attention to the serious results to agriculture already in progress owing to the rapid wastage of woodlands, and his warnings had induced the Court of Directors to send out a dispatch (No. 21, dated 7th July 1847) asking the Government of India to investigate and report to them the "*effect of trees on the climate and productiveness of a country, and the results of the extensive clearances of timber.*" After a lapse of fifty-nine years Mr Wilmot's bulletin is a long-deferred reply to this request, and, of course, it is made with special reference to existing conditions. In it he points out the obvious fact that the beneficial mechanical effects of forests should be all the greater when rainfall is either superabundant or scanty, when the temperature is high, and when the hill-sides are steep; hence tropical or sub-tropical countries frequently present conditions where the conservation of forests in suitable localities may be of vital importance. In India this is the case. The chief industry is agriculture, dependent on a favourable water-supply, provided either directly from rainfall or else indirectly from rivers, tanks or wells. And in the present condition of many parts of India dependence cannot be placed on seasonable rainfall, so that if precipitations of rain are allowed to run to waste, in place of being carefully conserved, India may in course of time find her rivers silting up and her canals running dry. Properly located forests tend to diminish this waste and to form natural reservoirs from which a perennial flow proceeds, and therefore in India the indirect value of forests is, perhaps, really greater than the direct benefits accruing as to timber, fuel, bamboos, etc., not forgetting the large net surplus of revenue annually enriching the Government treasury.

The denudation of the hills and river-catchment areas in India certainly affects larger interests than those of the individual or the local community, for the whole country suffers when famine occurs over large areas, as also in a minor degree when unloosed torrents cause waste of water which should be stored in the soil

for use in the dry season, and flood low-lying tracts throughout the lower courses of the rivers. But the important work of distributing the water-supply by canals, dams, tanks and wells is comparatively easy if rivers, streams and springs flow permanently and equably. Even if the protection and efficiency of large distribution works is alone considered, forest conservancy measures will, wherever this is possible, in future ensure a more regular and even supply of water to such works.

The great rivers of India are fed by the glaciers and snows of the Himalayas or trans-Himalayan tracts, while smaller catchment-areas are dependent on rainfall. It might be supposed that the flow of the glacier-born rivers is beyond man's control; but this is not so, for it has been proved that the catchment-area in the hills between the snows and the plains is that part of a river's course which should receive the most careful attention, because this is the area within which forests can prevent avalanches and torrents, and can store up a large proportion of the waters, to give them off gradually in perennial springs and streams. From the permanent snow-level to the upper tree-limit no protection is needed to control the course of the Himalayan rivers; but from this point onwards the influence of rainfall becomes all the more important with decreasing elevation above the sea-level—the rainfall being generally heaviest from the 7000 feet contour-line to the foot of the hills. At the top a stiff shrubby growth of dwarf rhododendrons and juniper forms an effective surface-covering. Close below are the birch forests; and below these the pines, firs and cedars forming dense forests; while lower still the pines and oaks merge gradually into the broad-leaved woods clothing the lower slopes leading down to the plains. If left untouched, this protective belt ensures an equable flow of the water down to these plains; and there can be no doubt that the lowering of the water-level in the great rivers, the drying up of springs, the covering of fertile agricultural lands with mountain débris, and the destruction of villages, towns and fields by disastrous floods, have been mainly due to the rash clearance of the primeval forest covering of the mountain slopes. Among numerous examples taken all over the country, Mr Wilmot quotes, in proof of this, one of the latest examples, and one peculiar in its way, which occurred in the summer of 1905 in connection with the Cauvery river, the water-level of which was reduced below the lowest estimates on which the Mysore electric

power works were based, so that great expense and inconvenience were incurred by the unexpected diminution of the power delivered under contract to the Kolar Gold-fields and elsewhere.

Although one-fourth of British India is under forest of one sort or another, the distribution of the forests throughout the country is not such as to efficiently regulate the water-supply. The catchment-areas of many rivers are in Native States, and thus outside the control of the Forest Department. This is specially the case as regards the important Upper Indian rivers, upon which the chief irrigation works depend. And many of the chief rivers of other provinces also have their catchment-areas in Native States. The main issue of the present situation is that effective steps of some sort must be taken by the Government of India to safeguard and improve the catchment-areas of all important rivers situated in Native States, and this matter is undoubtedly one of great urgency in many parts of the country. In fact, the matter seems ripe for early consideration at the hands of a small Commission appointed to tour round the country and submit a report. The value of the work of such a Commission would be incalculable.

Among recent protective measures required to prevent the destruction of agricultural land through sand-torrents (*chôs*) let loose owing to reckless clearance of the natural woodlands that formerly kept the soil fixed *in situ*, the chief has been the Punjab Land Preservation (Chôs) Act, which aims at protecting the forest-clad slopes of the lower Himalayas from denudation by graziers. Although only a short time in force, this Act has already been productive of improvement. In the Hoshiarpur district, where these *chôs* are most destructive, excellent work is being done, although the people think it a great hardship and do not realise the good results that will follow. All the bare slopes which gave rise to these sand-*chôs* have been or are being made Reserves, and the rights of the people therein are being compounded, so there is every probability that all the remaining valuable cultivation will escape the calamity. Attention is not yet being paid to the Jhelum district, where there is a [illegible] of small hills running almost north-east to south-west parallel to the river. Between the hill series and the Jhelum river there are large tracts of valuable and fertile fields, which year after year are being encroached upon by the sand brought down by the ravines (locally called *kas*). These *kas* are increasing in dimensions year by year. Between Jhelum town and

Sanghoi village, a distance of 9 miles only, there are five or six such *kas*, one of which (specially called *kahan*, and only about 3 miles from Jhelum) is now about 1½ miles in breadth. All these *kas* bring down every rains an immense quantity of sand on to the cultivation. During the last ten years between Jhelum and Sanghoi two new *kas* have appeared, so that the devastation caused is on the increase. In February 1906 the big *kahan* shifted its course and turned towards the cultivation of the villages Naugran, Kot and Aryala, thus covering valuable fields with sand, and creating also a new *kas* near the village Naugran. Great devastation is being done. All the hills are absolutely or nearly bare. They consist of loose sandstone with very little vegetation, and there is nothing to prevent the water carrying the sand down towards the Jhelum river. As there are fewer executive difficulties than was the case in the Hoshiarpur district (for all these hill tracts are already Reserved Forests, and the people have only limited and defined rights in them), it is to be trusted that the Government may soon try to restock the hills, and thus save the cultivators from the calamity which is otherwise impending.

Throughout the Punjab much is also being done in the way of planting trees along the road-sides. During 1902 to 1905 nearly 600 miles were planted, 76 per cent. of which were successful. This is a very satisfactory result, seeing that the work was mainly carried out in Mianwali and the two Canal Colonies, which are all districts in the arid region. Of the roads suitable for arboriculture, 53 per cent. have now been planted with trees at a heavy cost, met from Government grants made to district boards.

The Irrigation Department during 1902-05 planted over 1000 miles of avenues, and more than half the total length suitable for tree-planting has now been stocked. The planting chiefly took place in the arid western districts of the Province, where the Jhelum river and the Chenab Canals enabled a high percentage of success to be achieved. Some 2700 acres of nurseries were started with excellent results, the failures representing only one-fifth of the whole. Arboricultural operations cost over £20,000. But the Buildings and Roads Branch of the Public Works Department made tree-planting profitable, and realised £1100 net revenue from their operations. About two-thirds of the total length of the roads considered suitable are now planted with trees, and the percentage of failures is low.

The Punjab Government has urged upon district officers to keep in view as the chief means of successful tree-culture (1) the enlistment, by their own interest in the matter, of the active help of the villagers, and (2) the employment of a properly trained expert as district forester, whose time will be taken up chiefly with the care of living trees, and not with the sale of dead ones.

In the Madras Presidency the first results of an important experimental cultivation of trees, shrubs and other plants to provide leaf-manure for agriculture were published at the close of 1905. In May 1904 the Madras Board of Revenue accepted the proposals of the three Conservators of Forests to sow the seeds of suitable varieties in selected places in the reserved forests in Tanjore, Trichinopoly, North Salem, North Arcot and Chingleput districts (Central Circle), and in the unreserved lands and reserved forests of Madura and Tinnevelly (Southern Circle). The Collectors of other districts, where it was considered that the existence of a sufficient supply of green manure rendered such measures superfluous, were asked to see that the supply available was placed at the disposal of the cultivator at a price suited to his means. The Board at the same time urged that every encouragement and assistance should be given to peasants wishing to grow such plants, shrubs and trees on their own lands. Experimental cultivation was undertaken on a limited scale in the Chingleput, North Arcot, Tanjore, Trichinopoly, Madura and Tinnevelly districts. Except in Madura all proved a failure, chiefly owing to the unfavourable character of the season. In Madura, two blocks of unreserved lands were selected with an aggregate extent of 70 acres, lying in the Periyar zone and easily accessible. Seeds of *Cassia auriculata* mixed with a small quantity of seeds of other species were sown broadcast. Seedlings have sprung up over three-fourths of the area sown, and are thriving, although, owing to scanty rainfall, their growth is not so good as it might otherwise have been. It is hoped that after from three to five years their leaves can be cut and used as manure. In the Central Circle no such experiments were undertaken in North Salem, but two plots with a total area of 168 acres were prepared for sowing in 1906. The attention of Collectors has again been drawn to the importance of placing a good supply of leaf-manure at the disposal of the cultivators at moderate rates wherever the want of it is felt. But in Tinnevelly the offer of grants of assessed

waste land free of assessment for five years for the purpose of cultivating *Tephrosia purpurea* and other shrubs suitable for leaf-manure met with no response.

The Para Rubber Plantation at Mergui, in the Tenasserim division of Burma, in the south-eastern part of the province running down to the Malay Peninsula, "has been recently extended by 819 acres, at a cost of £764." Begun in 1900, the portions first planted began to reach tapping-size in 1905, when 793 lbs. of dry rubber were sent to London, and sold for 4s. 8½d. a pound. Mergui is, however, a little too far north of the equator to provide the special climatic conditions for the proper thriving of the *Hevea brasiliensis*, which belongs purely to the equatorial regions of Para in the Amazon delta; and, consequently, it is there even more likely to be attacked by noxious insects and fungous diseases than will probably be the case in localities nearer the equatorial line, such as Ceylon, the Malay States, Sumatra, Java and Borneo, or the equatorial districts on the west and east coasts of Africa. But throughout the hills and plains to the south and east of the Amazon delta, the region to which the *Hevea* is indigenous, this Para rubber tree occurs only sporadically scattered throughout a multitude of other trees in the dense forests,—whereas, for the sake of economy and labour-saving in planting, weeding and cleaning, tapping, and supervision and management generally, rubber-plantations in Ceylon, the Malay States and elsewhere are being formed pure, or else the trees are grown as standards about 15 to 20 feet apart over ground-crops consisting of tea-bushes, lemon-grass, cacao, etc.; and consequently there is the great danger of somewhat the same results being produced (*quod dei avertant*) as have occurred with us in regard to larch plantations, namely, the fostering of fungous disease of little danger while the host-plant grows only sporadically among many other trees, but almost certain to develop into a dangerous epidemic when pure plantations are formed extensively.

This is, unfortunately, only too real a danger. Para rubber plantations in Ceylon and the Malay States have already shown themselves liable to attacks by rats, insects, and fungous diseases. The two chief diseases of the latter sort are caused by species of *Nectria* attacking stem and branches, and species of *Fomes* attacking the butt and roots. Though no very serious results have yet been recorded, there can be no doubt that these

fungous diseases constitute a grave source of danger. In these hot, damp, tropical climates fungi can increase with terrible rapidity, as was shown when the disease caused by *Hemeleia vastatrix* almost entirely destroyed the Ceylon coffee plantations about thirty years ago, and utterly ruined that profitable industry.

The Mergui plantations have, of course, not been exempt from insect and fungous attacks; and in 1906 it was found that at least three different kinds of white ants (*Termites*) were attacking the trees, first enclosing the trunk in a thick crust of earth, and then eating through weak spots into the heart of the tree. Two of these were recognised as *T. Gestroi* and *T. annamensis*, but the other specimens have not yet been identified, nor is their life-history known. Similar attacks by white ants had previously been reported from Borneo, Singapore, and the Malay States; and it is to be feared that these *Termites* may become dangerous pests in the rubber plantations throughout the Indo-Malayan region.

Elsewhere, what appears almost certain to be a fungous disease has recently become noticeable in the Deodar plantations made in the Kulu district of the Punjab Himalayan tracts. Cultural operations for artificial reproduction of Deodar were begun in Kulu about 1875, when four reserves were constituted and a plantation was made in each, the planting being done in lines 10 feet apart. All four plantations are on the bank of the river Blu, on almost level ground full of big boulders. Their joint area is 189 acres, and they are now more or less fully stocked, with blanks here and there. The total cost on these plantations has been up to date about £630, or £3, 6s. 8d. per acre, which is somewhat high. The trees now girth 3 to 4 feet, and most of the plantations require thinning. They would be of considerable value had not fungous disease sprung up in two of the above forests, from which all the trees are now dying. It appears first in the upper part of the tree, where the top leaves begin to thin out, until the top dies; then it travels downwards until the tree dies altogether. In 1903 this disease was limited to one of the forests (Sial Bihal Reserve), in which a few of the trees were infected. But by 1906 the whole of this forest was infected, and the disease had spread into Dana Bihal Reserve, the infected trees being scattered over the whole area, no healthy compact groups being now left. It was at first thought that as the trees were growing on the river banks

on a level, undrained soil, they died as soon as their roots reached the water-level; but there are a good many thriving old trees of 10 to 15 feet girth. Some diseased trees were therefore felled, and the heart-wood was found to have an abnormal colour, and to emit rather a strange, unpleasant smell. Some infected trees were also dug out, and a search was made for insects or fungi, but without success. It is probably a fungous disease; but whatever its cause, the disease seems to be fast spreading. Up to now it has been seen only in the plantations, but it may soon spread to the numerous Deodar trees growing spontaneously in the locality.

Since its foundation (in 1878) a fine Forest Museum for all India has been formed at the Dehra Dún College, but within the last five years a good beginning has been made in forming local or provincial forest museums. In 1902 Mr Gass, Conservator of the Southern Circle of Madras, started a collection of specimens of timber and other forest produce, and set apart one of the rooms in his office for this purpose. It was then intended that the collections should be limited to that Circle, and, with the approval of the Board of Revenue, a circular was issued to all forest officers in the Circle explaining the object and scope of the proposed institution, and communicating the heads under which specimens were required. Specimens soon began to arrive, and increased in number so rapidly that it soon became evident that a most interesting and instructive forest museum could be formed if its scope were extended to the three Circles of the Presidency. This has since been done, and the practical value of the museum has become so evident that in 1906 the late Governor (Lord Ampthill) sanctioned the erection of a special building for housing the exhibits on up-to-date lines.

Of the 100,000 square miles of reserved and protected State forests in India, 70,000 have now been surveyed, chiefly on the four-inch scale, and the forest maps are probably superior to those of any other country in the world. But, as many of the remaining 30,000 square miles of unsurveyed forests are not of sufficient present value to justify the extra expenditure, the existing one-inch maps will probably in most cases suffice in the meantime. Since 1904 the Superintendent of Forest Surveys and the whole Forest Survey Branch have been placed under the direction of the Surveyor-General of India, in place of being, as formerly, under the direct control of the Inspector-General of Forests.

The Department is steadily striving to find uses and profitable markets for its produce. Throughout 1905 a wood-pulp expert from home was engaged at the Rangoon timber depôt in making experiments with bamboos and about a dozen different kinds of abundant trees as yet of little or no local value, in order to try and ascertain if there be any chance of producing a marketable pulp therefrom. A report has recently been issued as to the commercial prospects of the experiments, and the Local Government is now considering what offers should be made to induce private enterprise to take up this manufacture. The bamboo tracts abounding in Burma contain great possibilities as to higher-priced pulp for the finer kinds of note-paper. Twenty-five years ago I had much correspondence with the late Mr Thomas Routledge, of Claxheugh, on this matter, and he prepared excellent paper from bamboos which I sent to him. In quality he ranked these bamboos above esparto grass for paper-making. In 1882 or 1883 he obtained a concession for this purpose, but died before the company's work could be commenced. But the bamboo tracts are still there, awaiting exploitation by capitalists.

And it is not in Burma only, where 75 per cent. of the whole province is under forest of one sort or another, but throughout the whole of India, whose total extent of eleven hundred thousand square miles is covered with State forests (partly reserved, partly unclassed and unprotected) to the extent of nearly one-fourth, that forest produce is largely available for extraction—if only profitable markets can be found for it. At present there is a great wealth of fine, hard, beautifully-coloured and beautifully-grained wood, which, together with vast quantities of miscellaneous raw produce of one sort or another, are practically nothing more than waste products of the woodlands.

Efforts more or less successful are continuously being made to find remunerative markets for these timber-trees and other products. But it is more difficult to find a profitable market for any unknown kind of wood than for almost any other kind of raw product; and even though the Forest administration in India is officially classified as a "*quasi*-commercial department," its efforts in a mercantile direction are, of course, not permitted to have the freedom exercised by private merchants. Still, this matter is not being lost sight of; and the yield of the Indian forests may hereafter be expected to increase largely, both in volume and in money-value.

30. Forestry in the Exhibition at Nürnberg.[1]

During the present summer and autumn a most interesting exhibition of Bavarian industries has been held at Nürnberg, and in a country possessing 6½ million acres of forest (nearly one-third of the total land area), it was only natural to expect that Forestry would occupy an important section. In point of fact the forestal display, both in its industrial and educational aspects, is regarded as the finest that has ever been attempted. A few notes on certain special points may not be without interest to English readers.

Of the 6½ million acres of Bavarian forest land, the State owns about 2½ millions, private individuals about 3 millions, while villages, towns, and endowed institutions possess about 1 million.

Although Bavaria possesses such a wealth of wood, there are few countries where more attention is given to methods of preservation by means of impregnation. In Great Britain impregnation by creosote is by far the commonest practice, whereas in Bavaria, and in Germany generally, a mixture of creosote and chloride of zinc is most commonly employed, next follows chloride of zinc alone, and then comes creosote. The comparatively subordinate position occupied by creosote in Germany is not due to lack of appreciation of its merits, but is entirely a question of expense. In this country, with abundance of coal, creosote, a by-product, is cheap; in Germany, and especially in Bavaria, where coal is relatively scarce, creosote is dear, and more attention is given to other impregnating substances.

The different systems or methods of impregnation are classified as follows:—

Impregnation by Ascent, where posts or poles in a green state are set with their lower ends in a tank of the solution. As the sap of the wood is withdrawn from the top by natural evaporation, the solution enters below and rises in the cells and vessels, and in a short time (depending on the kind of wood) will appear at the upper surface.

Impregnation by Imbibition takes place where wood is thoroughly air-dried, and is then immersed in the solution. The water of imbibition, which is in the substance of the cell-walls, is expelled and replaced by the solution.

[1] Reproduced from the *Journal of the Board of Agriculture* for September 1906, by permission of the Controller of His Majesty's Stationery Office.

Impregnation by Filtration, where the solution is stored in a tank at a higher level than the stem to be impregnated, to which it is led by a pipe which is closely fitted into a hole in the wood. In this case the solution is under pressure, and is thus forced into the wood.

Impregnation by Injection, where the wood is first artificially dried and is then placed in a steel chamber, from which air may be pumped, and into which the solution is introduced under a pressure of several atmospheres. This is the method usually adopted on a large scale in this country.

As is well known, different species of wood absorb fluids very differently, the least suitable for impregnation being those with a well-marked duramen. The difficulty in forcing fluids into such wood is due to the fact that their vessels are packed full of a cellular growth (*thyloses*), as may readily be seen through a microscope of moderate power.

As was to be expected in a national exhibition in the country in which Hartig laboured for many years, and where Tubeuf now holds the chief professorship of Forest Botany, the diseases of wood, living and dead, are illustrated by a wealth of material never before equalled. Perhaps the most interesting object in this sub-section is the model of a dry-rot chamber, the original being at Bernau on the Lake of Chiem in the Bavarian Highlands, some two hours by rail from Munich. The quality of timber is tested in many ways, by resistance to pressure, resistance to tension, specific gravity, etc. But for many purposes the important thing to determine is resistance to decay, and Tubeuf has hit upon a novel and effective way of applying this test in a reliable and fairly rapid manner. For this purpose he has had a wooden hut erected in a peat-bog, thus ensuring that it shall always be fairly moist, and into this house he has introduced a supply of old wood which is full of the dry-rot fungus. In order to test the power of resistance to decay of any species of wood, or of wood treated by any special preservative method, he places blocks of a given weight within reach of the fungus, and in a few months, or a year or two at most, definite information as to the rate of destruction can be obtained.

A number of cross-sections exhibit the inexplicable condition of things that growth is more rapid on the under side than on the upper side of the branch of a conifer, whereas in the

branch of a dicotyledon the opposite is the case. This may be seen by cutting off horizontal branches of the two classes of trees named. In the case of the conifer, the pith will be found to be nearer the upper than the lower side of the section, while in the dicotyledon the shortest radius is on the under side. The horizontally disposed roots of trees (the spruce is a good example) also show marked eccentric growth, but in their case the character of the eccentricity is always the same, the greatest growth, and therefore the longest radius, being on the upper side. It is evident that the upper side of a root is subjected to less pressure from the soil than the lower side, and as the cambium makes most wood where the pressure is least, the greatest growth is found in a root precisely where it is to be expected. But the variable condition of things in the branches of conifers and dicotyledons has always been a puzzle to botanists, and no satisfactory explanation is yet available. Nor is it quite easy to say why, in a tree grown on a steep hill-side, greater growth should be shown on the side away from the hill.

A fine series of young trees has been prepared to illustrate the fact that most of the roots of forest trees live in intimate association with delicate fungus mycelia (*mycorhiza*). This relationship has not been fully worked out, but it is evident that it is of the same character as the symbiosis that exists between the roots of leguminous farm and garden crops and bacteria. Sometimes the mycelia work their way between the cells of the epidermis and cortex (*e.g.*, Scots pine, spruce, beech, oak, birch), and roots so affected are called *ectotropic mycorhiza*. In other cases the fungus strands actually penetrate the cells of the root (*endotropic mycorhiza*), examples of which are *Thuya occidentalis* and yew.

In Bavaria, as in this country, oak bark has experienced a great drop in price during the past twenty years, the price per cwt. having fallen from 4s. 9d. in 1885 to 1s. 9d. in 1905. Concurrently with this decrease in value, the returns from coppice woods have steadily declined, being 13s. 9d. per acre in 1885 and 8s. in 1905. But during the same period the returns from high-forest have shown a satisfactory increase, having risen from 9s. per acre in the former year to 11s. 9d. in the latter. The cause of the fall in price of home-grown bark is the large increase in the importation of tanning materials, notably quebracho wood, specimens of which, and of the extract, were on view.

A number of interesting cross-sections were shown to illustrate the great increase in growth that results from heavily thinning a wood of oak or beech a few years before the final felling (*Lichtungszuwachs*). On the section a zone of a certain colour (*e.g.*, red) represents the growth made by the tree, during say ten years, before being isolated, while outside this the timber formed since the wood was thinned may be artificially stained green. The annual increment due to the admission of light is usually very great, and is often as much as 20 per cent., that is to say, a tree of 30 cubic feet may, in three years, have attained to about 50 cubic feet.

A number of cones formed of sections, two inches thick, taken every metre (3·3 feet) along an average stem, are shown illustrative of the yield of different species under different conditions. Thus, a beech-wood 131 years old in Spessart has an average height of 115 feet, and carries 7835 cubic feet per acre, quarter-girth measure. An average oak from a forest in Spessart (over 200 years old) is shown in section, the height being 119 feet, and the volume per acre, quarter-girth measure, 10,325 cubic feet. A spruce-wood, 60 years old, in the Bayrischer Wald is similarly represented, the average height being 86 feet, and the contents per acre 5820 cubic feet, quarter-girth measure.

The export and import timber-trade for the whole German Empire is represented graphically, and shows that whereas in 1880 the imports amounted to less than two million tons, valued at less than four million pounds, in 1904 they exceeded five million tons, valued at nearly twelve million pounds sterling. During the same period the export in timber fell from 830,000 tons, valued at a little over two million pounds, to 323,000 tons, of a value slightly exceeding one million pounds. Thus it is seen that, even with its gigantic forest wealth, Germany's timber imports greatly exceed the exports.

An interesting section of the Exhibition is concerned with the display of products chemically prepared from wood. In 1889 it was discovered that the cellulose prepared from spruce timber could be made to furnish an excellent artificial silk, not so elastic and strong as the real article, but superior to it in lustre. The annual production is now estimated at over two million pounds' weight, valued at 15s. per pound. It is now largely used in upholstery and for making ties and other articles of apparel.

More recently, artificial horse-hair has been produced from the same source.

Yarn from wood is now an important article of commerce. It is found to dye and wash well, and to be very durable. It is to some extent replacing jute, cotton, and linen.

By the action of alkalies, oxalic acid is now largely prepared from sawdust, 100 lbs. of the latter giving about 80 lbs. of the acid.

Acetic acid has long been distilled from wood, the firm of Lanfach in Spessart, who are exhibitors, consuming annually not much short of a million cubic feet of beech timber in this way. It is estimated that in the year 1900 about three and a half million cubic feet of wood were distilled in Germany for the production of four million pounds' weight of acetic acid, most of which was used in the production of artificial indigo, though some went to make table vinegar.

In the production of acetic acid, wood is placed in a retort and heated to a temperature between 536° F. and 608° F. It is found that wood treated in this way yields about 24 per cent. of charcoal and 50-54 per cent. of liquids, while 22-24 per cent. goes off as gas. The liquid portion, by further treatment, yields 6-10 per cent. of tar, 3-10 per cent. of wood-spirit, and 5½-6½ per cent. of acetic acid.

Doubtless the most important substance produced by the chemical treatment of wood is cellulose, for the production of a ton of which some 230 cubic feet of timber are required.

In Lower Bavaria (Niederbayern) private forests cover an area of some 650,000 acres, and constitute 79 per cent. of the total wooded surface. In the beginning of last century there was a strong movement on foot in this district to split up and apportion communal forests amongst those who had rights over them, with the result that the present owners, in some cases, possess a piece of woodland only a few yards wide, and as little as a quarter acre in extent. Naturally, the management of these woodlands leaves much to be desired, and the State in 1900 appointed six forest experts, with ten assistants, whose chief business it should be to effect an improvement in these private woods. State nurseries (covering 120 acres) for the supply of plants of the best quality at cost price have been established in many places, the number of young trees distributed last season being 18½ millions

31. Aberdeen Branch.

Excursion to Drumtochty, Kincardineshire, 9th June 1906.

The first excursion of this Branch of the Society took place on June 9th, 1906, when, by the kind invitation of Sydney J. Gammell, Esq. of Drumtochty and Countesswells, the beautiful Estate of Drumtochty, Kincardineshire, was visited by a party from the associated counties of Aberdeen, Banff and Kincardine. The party travelled to Fordoun by rail, and thence they were conveyed in brakes to Drumtochty, where, on arrival, they were met by Mr Gammell.

Led by Mr Gammell and his forester, Mr Mitchell, the party were conducted to a larch plantation, stretching along the east end of Finella hill. This plantation extends to about 120 acres, the lower part being about fourteen, and the upper part from seventy to eighty years old. Before entering the plantation, Mr Gammell exhibited a plan of his estate, coloured so as to show at a glance the portions which had been planted, particularly in the last fifteen or twenty years, and indicating the kinds of trees which had been used and the age of the plantations. Mr Gammell explained that he kept a record of the acreage and kinds of trees planted; the cost of plants, planting, and tending; and the progress made at certain stages. The general plan on which he proceeded, he explained, was to lay down a two-storied high-forest on the upland parts of the estate. At the end of twenty-five years the first thinning took place, and at the end of the second twenty-five years the wood was very heavily thinned and underplanted with Douglas fir, the estimate being that the latter would, at the end of fifty years, be as big as the larch at eighty or one hundred years. About 50 acres of the lower portion of the Finella plantation was planted some fourteen years ago with larch, mixed with a sprinkling of Scots pine and spruce. This was immediately after the great storm which did so much damage to the woods in the east of Scotland. The upper part of the wood consists of very fine larch, apparently between seventy and eighty years old, but it was the opinion of the majority of the party that the timber should now be cut, and that little advantage was to be gained by allowing it to remain standing much longer.

An extensive young plantation of larch raised from Tyrolese seed was next inspected. This covered a large expanse of hill-side, from which a crop of larch had been cleared some years ago, the plants having been put in at 3 feet apart. Mr Gammell also showed another young plantation of larch raised from home-grown seed, and some discussion arose as to the comparative merits of the two kinds; but in both cases the plants were so small that it was very difficult to form a definite opinion on the matter.

A visit was paid to the nursery, where many young trees, including larch, spruce, mountain pine, Douglas fir and broad-leaved trees, especially oaks of both the sessile and pedunculate varieties, were being reared. The party next proceeded to inspect a fine nine-year-old larch plantation. This showed much better growth, and had an altogether healthier appearance than the Finella plantation, the improvement being explained by the fact that the trees had been planted in soil which had previously carried a crop of timber, and which had a considerable depth of humus; and Mr Gammell expressed the opinion that, in cases where this could be done, it would pay proprietors to plant trees on bare parts of their estates, if only to prepare the ground for the reception of a second crop.

The party were now conducted to an older plantation which had been severely thinned and underplanted with Douglas fir, spruce, and silver fir, all of which were very healthy, and promised to form a fine second crop. Some little damage was noticeable here, presumably from roe-deer. On the way to the saw-mill a very fine specimen of *Picea sitchensis* (*Menziesii*) was seen. It had a height of about 87 feet, a girth at 5 feet from the ground of 11 feet 3 inches, and a spread of branches of 61 feet. Several other good specimens of the newer Coniferæ were also observed here, notably a very fine *Cupressus macrocarpa*, about 40 feet high, and growing vigorously.

The estate saw-mill and workshops are admirably arranged. The saw-mill is driven by a water-turbine, the water for which is taken from the Luther, and conveyed by a lade built of concrete. The turbine develops about 13 horse-power, and it also drives all the machinery in the estate carpenter's shop.

Luncheon was served in one of the offices, and thereafter

a general meeting of the Branch was held. Mr Gammell, one of the vice-presidents, in the unavoidable absence of the President, Mr Gordon of Newton, presided. The transaction of the formal business over, a hearty vote of thanks was, on the motion of Mr J. Michie, M.V.O., Balmoral, accorded to Mr Gammell for permitting the party to visit his estate, and for his kindness in presiding over their meeting. In acknowledging the vote, the chairman stated that he was pleased to welcome them to his estate, and that it afforded him the greatest pleasure to be able to contribute in any way to the advancement of forestry.

After a visit to the intake for the water for the saw-mill, the party were conducted through another mixed plantation on the north side of the glen, and then, descending the hill, the route lay through an old, mixed plantation, stretching along the bank to the castle. Here some very fine silver firs were met with, one of which measured about 104 feet in height, with a girth at 5 feet from ground of 10 feet 10 inches, and a spread of branches of 38 feet; and there were others of almost equal size. Several very fine straight-stemmed oaks were also seen here. These appeared to contain from 80 to 100 cubic feet of timber each, and they indicated perfect health and thorough suitability to the soil and situation.

After visiting the castle and its well-kept grounds, the party wound their way back to Auchinblae, where the brakes were in waiting to convey them to Fordoun, a highly interesting and instructive tour having been enjoyed. The arrangements reflected the greatest credit on the Hon. Secretary, Mr R. Scott, and the thanks of the party are due to Mr Mitchell, the forester on the Drumtochty estate, for the tree-measurements given here, and for the attention he gave to the Excursionists.

The party included Lieut.-Col. Innes of Learney, and Professor Trail, Aberdeen, *Vice-Presidents* of the Branch; and Messrs Irvine, of Drum; Fleming, of Dalmuinzie; Michie, Balmoral; Braid, Durris; Hart, Cowie; Bruce, Dunnottar; Greig, Aberdeen University; France, Aberdeen; Clark, Haddo House; Crozier, Durris; Harper, Aberdeen; Maxtone, Duff House; Ewing, Strichen; Wylie, Ballogie; Sim, Park; Singer, Castle Newe; Bell, Forglen; Reid, Durris; Bremner, Durris; Hutton, Glendye; Fraser Smith, Auchnagatt; A. Cocker, Aberdeen; Duthie, Aberdeen; Cumming, Aberdeen; Gray, Aberdeen; Robertson, Durris; Bowman, Durris; Fyfe, Durris; Stephen, Drumtochty; Goodson, Drumtochty; and Robert Scott, Aberdeen, *Honorary Secretary* of the Branch.

Excursion to Strathbogie, Aberdeenshire, 1st September 1906.

The second excursion of the Branch took place on September 1st, 1906, when, by the kind permission of the Duke of Richmond and Gordon, K.G., a visit was paid to His Grace's Strathbogie estate. The party assembled at Huntly station, and, under the guidance of Mr John Rule, forester at Huntly Lodge, they were conveyed to their destination in brakes.

The first halt was made at Dunbennan plantation. This plantation is eighteen years old, about 300 acres in extent, and is 550 to 600 feet above sea-level. In some parts of the ground which are damp the plants have died, so that the plantation is patchy. In the part inspected the trees are irregular in their growth, and under the average height, the larch being from 16 to 18 feet, and the Scots pine from 10 to 14 feet, whereas in ordinary soil suited to their requirements they should have been from 23 to 25 feet, and from 17 to 20 feet respectively; but in other parts of the plantation the growth is much better.

Binhill plantation was next visited. The first part inspected is about 500 feet above sea-level, and has a western exposure. The crop consists of healthy larch and Scots pine, planted in 1839, and now 50 to 55 feet high, with well-developed boles containing from 12 to 15 cubic feet each. The crop, however, is too thin, there being only from 50 to 100 trees to the acre.

After refreshments, kindly provided by Mr Duff, Factor, Huntly Lodge, Mr Rule and his assistant, Mr Wilson, took the party to the Elfhouse Cave, an historic spot at an elevation of 850 feet. Here plenty of healthy trees, chiefly larch, from 40 to 50 feet high and from 8 to 10 inches in diameter, were seen; and lower down the hill was a fine lot of larch containing from 15 to 18 cubic feet of timber each. Mr Rule gave the following interesting particulars as to the cost of planting the Binhill wood, which is $2\frac{3}{4}$ miles from east to west and $2\frac{1}{4}$ miles from north to south, and contains 2258 acres:—

Fencing (Galloway dyke of angular stone, $3\frac{1}{2}$ feet high, at 6d. per yard, including carriage),	£464	4	3
Draining (open drains in wettest parts, 1 to $1\frac{1}{2}$ foot deep, $1\frac{1}{2}$ to 3 feet wide at top, and 12 inches wide at bottom),	225	15	7
Road, 15 feet wide,	180	0	0
Grubbing of whins, etc.,	54	0	9
Planting 2257 acs. 2 rds. 1 pole with 6,387,017 trees (= 2830 per acre), as per contract,	1956	0	0
Expenses of survey,	76	12	11
(= £1, 6s. per acre)	£2956	13	6

The planting was commenced in March and completed in December 1839, and the contractor upheld the plantation for four years. During this period 100,000 plants were required to fill up blanks caused by ordinary failures; but as many of the plants had been placed in situations unsuited to them, the blanks caused by the failure of these were filled up at the expense of the proprietor, for which an additional 260,000 larch, 340,000 Scots pine, and 50,000 spruce were required. Mr Rule also stated that, owing to there being little food for them in the vicinity, rabbits had not been numerous or given much trouble.

Between Binhill Forest and Roadburn Farm lunch was served. Mr Innes of Raemore proposed a cordial vote of thanks to the Duke of Gordon for his kindness in allowing the party to visit his property, and to Mr Duff for presiding at the luncheon.

The party next entered the part of Binhill plantation known as Ord Fell. This has a north-easterly exposure, with an elevation of from 450 to 816 feet. The crop is chiefly larch of medium size, and apparently fully matured. A part of this has been sold to Messrs A. & D. F. Lockhart, Timber Merchants, Huntly, and Mr A. Lockhart kindly furnished the party with the following particulars regarding the clearing operations:—

The area under clearance consists of 70 to 80 acres, carrying a crop of larch, spruce, and Scots pine in the proportions of 70 per cent. larch, 20 per cent. spruce, and 10 per cent. Scots pine. The ground is sloping, and the saw-mill is placed at the bottom of the slope, along which a light railway has been laid to bring the timber to the mill. Steel rails 12 and 15 feet long, and 14 lbs. to the yard, are used, and these are laid on light sleepers placed 3 feet or so apart. The bogies consist of a framework of two parallel beams, 9 feet long and 3 feet apart, braced diagonally, and carried on two axles with wheels about 20 inches in diameter on all four of which a brake is arranged to act simultaneously. Cross beams on the top of this frame bear the load, and about 3 tons can be carried by a bogie. The larch is peeled, the bark being taken off in 3 feet lengths and spread out, usually over felled trees, to dry. With two or three weeks of good weather it is generally ready for threshing, for which purpose it is gathered into large heaps. It is broken into pieces about 3 to 4 inches square by means of flails, and it is then filled into bags.

Prices for larch vary from 1s. 3d. to 1s. 6d. per cubic foot. Larch pit-wood in long lengths, 4 to 5 inches in diameter at the small end, last year brought 26s. to 31s. per 100 lineal feet, but this year it only brings from 24s. 6d. to 30s. Scots pine staves and heading of good quality fetch from 65s. to 70s. per 1000 superficial feet. Scots pine sleepers 9 ft. by 10 ins. by 5 ins., with a slab of not less than 8 ins., vary from 2s. 6d. to 2s. 9d.

Refreshments were offered by Messrs Lockhart, and Mr Duff read a telegram he had received from Mr Muirhead, Commis-

sioner on the estates, expressing his regret at not being able to be present, and he also gave extracts from a paper read by Mr Cumming, late forester at Huntly, at a meeting of the Northern Horticultural Association in 1888, in which he claimed that the effect of planting the Bin and other woods had been to make the season nine days earlier on the average in spring, and to render the winter milder. On behalf of the party, Mr Duff proposed a hearty vote of thanks to the Messrs Lockhart for all the interesting information they had supplied regarding the timber-clearing operations and for their hospitality, to which Mr A. Lockhart briefly replied; and on leaving the Binhill plantation they proceeded towards Huntly Lodge by way of the Crowwood, which consists of old Scots pine with boles about 15 feet in length, many of which measure from 7 to 8 feet in circumference at 5 feet from the ground, and wide-spreading heads. At Huntly Lodge the party were entertained to tea on the lawn by Colonel Cumberland and Laura, Lady Grant, to whom, on the motion of Mr Irvine of Drum, a vote of thanks was cordially given, and the party then repaired to the station, where, on the motion of Mr Scott, the Hon. Secretary, a hearty vote of thanks was accorded to Mr Rule for all he had done to promote the success of the excursion.

The party included Messrs Forbes Irvine, of Drum; Innes, of Raemore; Duff, Huntly; Dawson, M.A., B.Sc., Aberdeen; A. and D. F. Lockhart, Huntly; Crozier, Durris; Hutton, Glendye; Fyfe, Aden; France, Aberdeen; Cumming, Aberdeen; Sim, Cornhill; Smith, Drummuir; Bremner, Durris; Gauld, Blairmore; Singer, Strathdon; Clark, Haddo; Lobban, Fyfe Keith; Milne, Aberdeen; Cocker, Aberdeen; Harper, Aberdeen; Dunbar, Huntly; and Scott, Aberdeen, *Hon. Secretary*.

NOTES AND QUERIES.

The English Elm in Scotland.

The English elm (*Ulmus campestris*) is not a favourite tree with Scottish planters, and all the authorities pronounce it inferior to the Wych elm (*U. montana*) for the Scottish climate. I am unable to agree in this opinion, and, having had a discussion upon it lately with a friend who is making observations on tree-growth, I took the measurements of individuals of both species growing together at Monreith, with the following result.

	Age.	Height.	Girth at 4 to 5 feet.	Clean Bole.	Remarks.
		Feet.	Ft. Ins.	Feet.	
1. English Elm,	About 100 years	68	8 4	20	These four trees are the largest of their species growing together within a radius of 100 yards in woodland, exposed to S.W., where there is a lake half a mile long admitting full force of sea wind. Sea distant about 1¼ mile to S.W. Soil, hazel loam on boulder clay.
2. English Elm,	Do.	68	8 3	25	
3. Wych Elm,	Do.	65	10 0	15	
4. Wych Elm,	Do.	62	8 2	30	
5. English Elm,	Do.	62	9 9	12	These trees are in open park much exposed. Wych elms of same age near them are not half the size. Soil, same as last.
6. English Elm,	Do.	63	10 5	8	
7. English Elm: small-leafed or "Southampton" variety.	About 56 years	54	4 7	25	These trees are growing together in woodland; exposure, S.E. Soil same as last, but stiffer. The Southampton elm spreads rapidly by suckers.
8. Do.	Do.	57	5 1	24	
9. Wych Elm,	Do.	54	5 2	15	

These results confirm me in my impression that the English elm, which does fairly well on this exposed seaboard, would flourish finely if it got a chance in more sheltered districts in Scotland. It is far less troublesome in a wood than the Wych

elm. Of course the dimensions of these trees compare unfavourably with those of either species in less exposed districts. We lie open to the full force of S.W., W. and N.W. winds from the sea.

HERBERT MAXWELL.

NOTE ON THE BEECH FELT SCALE.

(With Plate.)

The Beech Felt Scale (*Cryptococcus fagi*), as pointed out in a recently issued Leaflet (No. 140) by the Board of Agriculture and Fisheries, is probably one of the worst pests that foresters are called upon to deal with.

In Scotland it has hitherto been most troublesome on the east coast and in Perthshire, but it has by no means been confined to these areas, and it is now increasing rapidly in the western and south-western counties. Until a year or two ago there was little or no evidence of its presence here, but isolated trees have been observed and treated during the last two years, and still odd trees come under observation.

In the early stages of attack it is not easily seen, as the insect is very minute, and generally scattered over a large area of the trunk and larger limbs; and it is only when the attack becomes chronic, probably in the second or third year, that it becomes so prominent, through the increase of the colonies, and the accumulation of the white felty secretion, as to be quite visible to the casual observer.

The insect, small as it is, seems to have its likes and dislikes, as it may attack one or more trees in a group, leaving others quite as tasty, to all appearance, untouched. The parts attacked are generally those away from the direction of the prevailing wind, while on horizontal limbs or branches it is almost invariably the lower side. This would look as if they preferred the position where the bark was thinnest and most succulent, as well as the most sheltered positions. While this may be so, colonies are found on exposed sides, and in fissures on the roughest bark, even near the ground. One remarkable feature is that of all the stems attacked here, only one showing the canker-spots of *Nectria ditissima* has been attacked, the insect seemingly avoiding such as being too dry in the bark for their liking. As to whether the fungus may follow in the wake of the insect, time will tell.

Entomologists are only acquainted with the female of this family, which is closely allied to the *Aphidæ*, but further investigation may prove that both male and female exist at certain seasons of the year, while the larvæ are yet actively engaged looking for new spheres of action. Once the female settles down in earnest to egg-laying, the felted appearance becomes more and more marked.

A number of experiments have been tried here with a view to finding out the most efficacious method of destroying the pest. The three recipes given in the above-mentioned leaflet, being more or less difficult to apply, and the caustic alkali wash requiring repeated applications before being effective, a cheaper and simpler wash is necessary where a large number of trees are infested.

A weak wash of creosote (half a gallon of creosote to five gallons of water) was tried on the lower limbs of one tree, with perhaps the best results as far as the destruction of the insect was concerned; but while no apparent damage to the health of the tree followed, the stained appearance would disfigure specimen trees.

A simple and effective wash is one composed of 1 lb. of Life-buoy soap to three gallons of water. The soap is first cut up and then put into a strong galvanised pail, the necessary water added, and the whole gently heated over a fire until the soap is dissolved. It is then ready for use, and should be applied with an ordinary scrubbing-brush, and well rubbed into the bark to break up the colonies. It thickens more or less rapidly, according to the temperature of the air, and should be reheated occasionally to make it thin and easy of application. One application of this wash has been found to be quite effective in destroying both insects and eggs on the smooth bark; but where not carefully applied to the fissured and rough bark, a few eggs have been found to hatch out during the summer following, and a second dressing has been necessary. For cheapness, efficiency, and ease of application, this is the best wash that has been tried here, and with it a couple of active men can soon get over a large number of trees. It may be applied at any season of the year, but as it works into a lather and dries on the tree, sticking until washed off by rain, when the stems are left clean, dry weather should be taken advantage of.

GEORGE LEVEN,
Auchincruive.

[*To face page 246.*

Resistance of Young Trees to Drought.[1]

At the last meeting of the German Forestry Association (September 1905), Oberforstrat Thaler and Forstrat von Pecklesheim gave an account of observations on the effects of the great drought of 1904 on trees planted in the previous season. In the districts under observation (Saxony and Hesse), scarcely any rain fell from the middle of April till the end of August. Conifers, except the Scots pine, were found to suffer more than hardwoods; the Weymouth pine, larch, and Norway spruce were most affected, while *Ailanthus glandulosa* and Scots pine suffered least.

It was only below an altitude of some 1300 feet that damage was done; at high elevations good growth was recorded. Some interesting facts are available as to the influence of the season of planting. Conifers planted late in autumn suffered more than those got in early, while scarcely a tree survived that was put in late in spring. The conifers which suffered least were those planted early in the spring season, that is, about February. Sowing was even less successful than planting. Keeping the surface of the ground open and clear of weeds by the use of the hoe was found to give good results. Side shelter from an adjoining wood was always beneficial, and the same was true with regard to considerable overhead canopy. Curiously enough, the effect of standards scattered thinly over the ground was distinctly bad.

Drought and heat are, of course, most injurious on south slopes, and to guard against their prejudicial effects the following points should be observed:—(1) regenerate under considerable overhead canopy; (2) where clear-felling is practised, take down the wood in narrow bands running from north-east to south-west; (3) preserve bushes naturally present: these will shade the young plants to some extent; (4) avoid opening up the wood by too early thinning; (5) in thinning, retain all underwood capable of growth.—*Zeit. für Forst- und Jagdwesen*, March 1906.

[1] Reproduced from the *Journal of the Board of Agriculture* for May 1906, by permission of the Controller of His Majesty's Stationery Office.

Diseased Scots Pines on Land formerly Arable.[1]

It is not infrequently noticed that when a wood of Scots pines, partly on land that has never been under the plough and partly on old arable land, reaches the age of twenty to thirty years, the trees under the latter conditions become unhealthy, and subsequently begin to die off. In the early years of the life of the wood, the trees growing on the land originally arable were probably the more vigorous, but in the middle or latter half of the rotation they are apt to develop unsatisfactory symptoms. The kind of soil appears to make no difference, the evil being found on dry sand as well as on good loam. The disease seems to start at certain points and to spread outwards. Scots pines alone are affected, all other trees being apparently immune.

The direct cause of the trouble has been traced to the attack of two root-fungi, *Polyporus annosus* and *Agaricus melleus* (or *Armillaria mellea*), the latter appearing subsequently to the former, and completing its work. Although these parasites are not unknown on other trees, they are chiefly met with on pines.

The subject is discussed by Forstmeister Frömbling in the March issue of the *Zeit. für Forst- und Jagdwesen*, who advances the theory that trees growing on old tillage land, being more "forced" in youth, have comparatively little power of resistance to attack. The fungi, too, find very favourable conditions of growth on old arable land, the residues of farmyard manure and the open texture of the soil favouring their development. Frömbling suggests that where it is intended to afforest arable land, the following points should be observed:—(1) avoid using Scots pines; (2) avoid using farmyard manure for some years before planting; (3) exhaust the soil by growing two or three corn crops in succession.

Degree in Forestry at the Edinburgh University.

The new Calendar announces that a Degree of Bachelor of Science in Forestry is conferred by the University, and gives details of the Preliminary Examination, the Courses of Instruction, and other matters connected therewith.

[1] Reproduced from the *Journal of the Board of Agriculture* for May 1906, by permission of the Controller of His Majesty's Stationery Office.

The Preliminary Examination will be in the following subjects:—(1) English; (2) Mathematics up to, and including, Plane Trigonometry; (3) German; (4) Latin or French.

The subjects of subsequent study, during a period of not less than three Academical years, will be as follows:—(1) Zoology; (2) Botany; (3) Natural Philosophy; (4) Chemistry, including Elementary Organic Chemistry; (5) Forest Botany; (6) Agricultural Chemistry, including the Chemistry of Soils; (7) Geology; (8) Forest Entomology; (9) Forestry, theoretical and practical, in all its branches; (10) Elementary Engineering; (11) Geometrical Drawing and Surveying. Some of these will be "full courses" and others will be "half courses." Five full courses, or their equivalent (counting two half courses as one full course) must be taken at the University of Edinburgh, and must include the course in Forestry. The remainder of the courses may be taken in other universities or other institutions approved by the University Court, or under teachers recognised by the Court for purposes of graduation in the Science of Forestry.

It is laid down that residence and practical work in forests will be required of each candidate to such an extent and under such regulations as the Senatus may from time to time appoint. In the present regrettable absence of facilities for giving adequate practical instruction in this country, it will be necessary for candidates to undergo a practical course of from nine to six months' duration abroad. But it is hoped that the early provision of a Forest Garden and a State Demonstration Forest (in which, if it comprised a fair amount of growing woods up to middle age, much instructive work could be done) will render it possible to greatly reduce the period of study abroad.

F. B.

The Study of Continental Forests.

Writing in the *Indian Forester* for March 1907, on "Forestry Tuition at Oxford and Dehra Dun," Mr A. J. Gibson says:—

"The Dehra Dun course gives a good grounding in forestry in all its branches, illustrated by an excellent and thoroughly practical outdoor programme of work; but the illustrations can only show Indian forests as they

are, and not *as they ought to be*, and this is where the home course is superior, for no high ideal of forestry is attainable from books, and it is the spectacle of a German or French forest intensely worked, which leaves an ineradicable impression on the forest probationer, and the probationer of to-day will be helping to mould the forest policy of India twenty-five years hence, and his model will still be the finished Continental one, modified by his Indian experience."

These words should be taken to heart by all who are interested in British forestry, whether as landowners, factors, foresters, teachers, or the authorities of institutions where forestry is taught. The words, used with regard to India, apply with equal or even greater force to our own country. In the preceding Note it has been said that practical training abroad is at present necessary for degree students and for others who may follow the higher courses; and it is hoped that our Society's Excursions abroad may be repeated from time to time, to enable our younger foresters, who have not yet had the opportunity of doing so, to see systematically-managed woods of middle to mature age, and thus to realise the results which such management leads to. But the urgent necessity for early provision of practical training grounds in this country is obvious.

F. B.

Educational Excursions.

During the past year, the first of a series of annual excursions was made to forests in Germany by a party of students from the Royal Agricultural College at Cirencester. They visited several State forests in the Oberförsterei of Darmstadt; also the well-known oak and pine woods at Viernheim, the extensive coppice in the Odenwald which is now undergoing conversion into High Forest, and some of the woods near Heidelberg. In this country, Lord Bathurst has generously placed his large woods, which almost adjoin Cirencester, at the disposal of the college authorities for instructional purposes. In addition to these woods, the students will visit the water-catchment areas of the Birmingham and of the Liverpool Corporations in Wales, which are now being planted up; also the Berkeley and Colesborne woods, the Forest of Dean, and the Brocklesby woods in Lincolnshire.

F. B.

School of Forestry in the Forest of Dean.[1]

The work at the School of Forestry which has been established by the Commissioners of Woods and Forests in the Forest of Dean is reported to have made satisfactory progress. As the result of experience, the course of instruction has been slightly modified and improved. Seven students entered the school in January 1904, and completed the course in October 1905. One has been appointed Assistant Crown Woodman in Windsor Forest, while the others are still in the Forest of Dean. A second class of seven students commenced in November 1904, two of whom were from private estates, and a third class of eight students began in November 1905, three being from private estates.

During the year a museum has been built at Parkend, and contains a number of specimens of various timbers, also specimens illustrative of damage caused by animals, insects, fungi, etc. These specimens are being arranged and labelled, and when finished will be of general interest, as well as of value to the forest student. The Abbotswood experimental plantation has been made over to the school; about five acres were planted this season, with mixtures of various species.—*Report of Commissioners of Woods, etc.*, 1905-1906.

The Yale Forest School.

The calendar of the Yale Forest School for 1906-7 contains an interesting account of the endowment and equipment of the school; it gives also the terms of admission, with the fees exacted from, and expenses incurred by the students. A full syllabus is added of the curriculum of study, which extends over a period of two years. In 1903 the Endowment Fund was increased by the gift of a sum of $50,000—a gift which affords a further example of the liberality with which scientific institutions "on the other side" are supported by private donors. F. B.

[1] Reproduced from the *Journal of the Board of Agriculture* for December 1906, by permission of the Controller of His Majesty's Stationery Office.

Timber-Supply from Sweden.

In the *Transactions* (Vol. IX. p. 337) is published an article on "Anticipated Curtailment of Timber-Supplies from Sweden," and as I find that the author has in some way over-estimated the influence of the law referred to therein, I beg to give the following contribution to the subject.

It is true that in the northern part of Sweden (Norrland) the law of the 27th April 1906 forbids the taking up of ground by saw-millers (or other industrial companies) to a greater extent than is necessary for building sites, timber depôts, etc. This law became necessary as the great companies more and more monopolised the ground, whereby our independent farmer-class in Norrland threatened to diminish to an alarming extent. Before the law was passed the companies purchased with ease large farms and woodlands—generally very cheap—and the farmers having spent the money they received in payment, awoke to the fact that they were without either money or home. Of course the farmer who sold his ground very often had the chance of becoming a tenant of the purchaser, but he thereby entered into a not very encouraging dependence on the company; and as the principal concern of the company was naturally its timber-business, and, as a rule, it paid very little or no regard to agricultural interests, the farmer sooner or later got tired of it, gave up farming altogether, and either betook himself to some other industry or, unfortunately, emigrated.

Since the passing of the law, the farmer can, as before, sell his timber, but he has greater difficulty in selling his land and home, and it is our hope that he will find it by and by more profitable to keep his farm and try to improve his agriculture. As our forestry laws have made the regeneration of our woods pretty safe, the farms have to be well kept up in forestry as well as in an agricultural way, and we shall preserve, I hope, for all time, a proprietary, independent, and happy farmer-class even in the northern parts of Sweden.

As for the influence of the law on the export of timber from Sweden, I am sure it will not cause a decrease but rather an increase. The exporting companies can even now, without any restriction, supply their timber wants by purchase from the farmers or from the government. The law in question will not, therefore, bring about a curtailment of timber-supplies to

Great Britain, but it will tend to reduce emigration to some extent, and will thus help agricultural interests in North Sweden; while last, but not least, it will tend to be a good factor in our efforts to build a firm base for a steady and enduring timber-stock in Sweden.

ELIS NILSON,
Ljungbyhed, Sweden.

"FROM THE ICE AGE TO THE PRESENT."

This extremely important and interesting article by Professor James Geikie, F.R.S., appeared in the *Scottish Geographical Magazine* for August 1906. Many years ago the Professor pointed out that the variation in the vegetation of the country, as indicated by certain deposits or layers of the peat-mosses, was the outcome of climatic changes, the forest beds indicating periods of relatively dry or continental conditions, while the layers of peat are the evidence of colder and moister conditions. Formerly, the views held by writers on the origin of Scottish peat-bogs were at variance and of an incomplete and unsatisfactory nature. The crux of the whole question was that they did not take into consideration the influence of climatic changes in bringing about the variation of the vegetation as recorded in the different layers of our peat-mosses. The soundness of the reasoning which led Professor Geikie to the conclusion that the succession of these types of vegetation were due to climatic influences has been recently confirmed by the admirable researches of Mr Francis J. Lewis of the University of Liverpool, who has shown beyond all doubt that the various types of vegetation found in each layer of the Scottish peat-bogs represent forms requiring special climatic conditions for their growth. In the limited space at our disposal it is impossible to give the various phenomena and their interpretation which gave the Professor the key to the correct solution of this interesting problem. It is of great interest to foresters, in so far as it deals with the appearance and disappearance of forests and the conditions attending these changes. After all, it would seem that the distribution or the occurrence or non-occurrence of forests in space and time are due to the same fundamental conditions, viz., climatic conditions.

A. W. BORTHWICK, D.Sc.

Reforestation in Scotland.

On the 12th March 1907, in the House of Commons, Mr Alden asked the Prime Minister whether there had been under consideration a large scheme for reafforesting 30,000 acres in Scotland; whether the House could be supplied with particulars of that scheme; and, if so, whether in the near future he saw any prospect of carrying it into execution.

To this the Prime Minister replied as follows:—I am informed that a scheme of reafforestation is under the consideration of the Commissioners of Woods and Forests. The scheme has not yet reached the stage at which it would be desirable for me to enter into detail, but I shall be happy to give further information on the subject if matters are, as I hope they may be, satisfactorily concluded.

The Denbighshire Experimental Station.[1]

A scheme for the treatment of the Chirk Forest Area, accompanied by a map, has been prepared by Mr Fraser Story. It includes a statement of the estimated expenditure upon work connected with the scheme. Seedling plants were purchased, some of them in Germany, and were developed in a home nursery at Iddon, while seeds were sown in another nursery at Groggen Iddon. The work proceeds under favourable auspices, and a satisfactory result may be confidently looked for. F. B.

The Isle of Man Arboricultural Society.

The Committee of the Isle of Man Arboricultural Society submitted the following Report at the General Meeting of the Society held on November 1906:—

The Committee have pleasure in submitting a report of the operations of the Society for the past year, together with the audited accounts for that period. These operations have been of a more than usually important character, owing to the

[1] See p. 108 of the present Volume.

departure made in the matter of undertaking the planting of a large tract of Slieuwhallin Mountain, which can be viewed from the plain surrounding the Tynwald Hill, at St John's. In this work no fewer than 48,300 trees of various kinds have been planted; and your Committee had, on the occasion of a recent inspection, the satisfaction of seeing that the plantation promises to be a success.

In addition to the planting on Slieuwhallin, the operations of the Society have resulted in the sale of 24,822 trees of several kinds, and, in addition to these, free grants of 2580 trees were allowed to customers; making a total of 75,702 trees planted during the year as the result of the operations of the Society.

Encouraged by the result of the Slieuwhallin plantation, the Committee are contemplating a similar work in the north of the Island. They also contemplate, on the recommendation of his Excellency the President of the Society, a limited experiment in what may be described as "broadcast sowing." If this experiment is successful, the adoption of this plan will conduce to economy in planting. The site selected for this purpose is considered to be well suited, so far as soil and aspect are concerned.

It may be noted that, in connection with the planting of Slieuwhallin, the sum of nearly £80 has been expended in labour, and the work of the Society has been of immediate advantage in that respect.

By Order of the Committee.

T. W. CREER, *Secretary.*

The chairman, speaking in April, on the occasion of the commencement by the Government of planting operations on a new site, stated that the Society had spread throughout the island much information regarding forestry, and had created a deeper interest in the subject. It had made persistent and successful efforts to obtain governmental support for its undertakings, and had secured an annual grant of public money. Land had been leased for afforestation purposes, and the leases were held by Government officers. The areas selected had been waste land, unfitted for agriculture, though well adapted to the growing of trees. The plantations would serve not only as a

much-needed shelter against wind, but would enhance the beauty of the island, and would also, in course of time, become remunerative.

[We congratulate the Society on its successful efforts to secure financial support from the Manx Legislature.—HON. ED.]

USE OF CREOSOTE OIL IN THE UNITED STATES.

Within the last four or five years there has sprung up in the United States a large demand for creosote oil on the part of the railway companies, who have commenced to creosote the sleepers and other timber used on their lines. In many parts of the States, timber is now very scarce, and consequently commands a high price, owing, no doubt, to its lavish and wasteful use in the past, and also the almost total neglect to plant trees.

Oil is sent from Canada, involving a journey by rail of 1500 to 2000 miles, and large quantities are also shipped from this country.

This should encourage tree-planters at home; for all the signs of the times point to a coming scarcity of timber, unless tree-planting is vigorously taken in hand by all countries which possess suitable soil and climate.

W. B. HAVELOCK,
Brocklesby Park,
Lincolnshire.

ORDNANCE SURVEY MAPS OF THE UNITED KINGDOM.

These maps can be purchased—(1) from agents in most of the chief towns; (2) directly, or through any bookseller, from the Ordnance Survey Office, Southampton (or, in the case of Ireland, from the Officer in Charge, Ordnance Survey, Dublin), by prepayment of the price of the map and the postage; (3) small scale maps are also on sale at railway bookstalls.

OBITUARY NOTICES.

Lieut.-Colonel Francis Newell Innes.

The news of the death of Lieutenant-Colonel Francis Newell Innes of Learney, which occurred very suddenly on 12th of April last, will be received with universal regret, and by none will his loss be more felt than by the members of the Royal Scottish Arboricultural Society.

The third, but at his death the only surviving, son of Colonel Thomas Innes, who at the ripe age of ninety-three is still an active member of more than one public Board in Aberdeen, Colonel Francis Innes entered the army in 1866, and served with distinction in the Royal Artillery in India, and in the Egyptian War of 1882. Retiring in 1886 with the rank of Lieutenant-Colonel, he returned to Aberdeen, and took over the active management of the family estates of Learney and Cullerlie, which were finally handed over to him by his father in 1892.

In addition to his duties on the various public Boards of the county, and of commercial undertakings in Aberdeen, in both of which he took a prominent place, Colonel Francis Innes personally attended to the management of his estates, and in no branch of estate management was he more deeply interested or more well versed than in that of forestry. He worked his woodlands systematically and well, as is abundantly shown, not only by the valuable contributions he has made to the local records on the subject, but also by the thriving plantations now to be seen on the estate. Though not previously a member of the Royal Scottish Arboricultural Society, it was only natural, when the local Branch was formed in Aberdeen, that he should take a prominent share in its inception, and his was one of the first names to be proposed for the office of Vice-President.

He had in the press, at the time of his death, a paper on "Forestry on the Learney Estate from 1806 to 1906," which appears in the present number of the *Transactions*, and our regret will be all the more keenly felt when we realise that this is the last contribution that can come from his pen.

S. J. G.

M. Lucien Boppe, C.I.E.

At the moment of going to press, we have received news of the death of M. Lucien Boppe, C.I.E., well known as the Professor of Sylviculture at the French National Forest School, and as an author of books on Forestry. A fuller notice will appear in January.

Hon. Ed.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING.

PROCEEDINGS IN 1907.

THE ANNUAL MEETING.

The Fifty-fourth Annual Meeting of the Royal Scottish Arboricultural Society was held in the Goold Hall, 5 St Andrew Square, Edinburgh, on Friday, 8th February 1907, at 2.30 P.M. Mr W. STEUART FOTHRINGHAM of Murthly, President of the Society, presided, and there was a good attendance of Members.

APOLOGIES FOR ABSENCE.

Apologies for absence were intimated from Sir John Stirling-Maxwell; Sir Charles Dundas of Dunira; Colonel Bailey; Professor Stewart MacDougall; Mr John Scott of Gala; Mr James Johnstone, Ayr; Mr John Black, Cortachy; and others.

MINUTES.

The Minutes of the General Meeting held at Peebles on 19th July last, which had previously been printed and circulated amongst the Members, were held as read and approved.

Election of Honorary Members.

On the motion of the President, the following were elected Foreign Honorary Members of the Society, as recommended by the Council, viz.:—Mr Kinya Kumé, Director-General of Forests, Department of Agriculture and Commerce, Tokio, Japan, and Professor Heinrich Mayr, Dr. Philos. et D.Œc., Professor of Forestry, Munich.

Report by the Council.

The Secretary then read the Report by the Council, as follows:—

Membership.

There has been a considerable increase in the Membership of the Society during the past year, but, as usual, large losses have been sustained through deaths, resignations, and lapses. Amongst those whose deaths have been recorded are—The Earl of Mansfield, an Honorary Member and ex-President of the Society; Mr William Mackinnon, one of the Vice-Presidents; Mr T. Valentine Smith of Ardtornish; Mr Walter Elliot, Manager, Ardtornish; and Dr Falconer, Lasswade.

At the date of the last Annual Meeting the Membership amounted to 1082. During the year 143 new Members have been elected, including 2 Honorary Members, but 66 names have been removed from the list owing to the causes mentioned above. The Membership at this date is therefore 1159, made up as follows:—

Honorary Members, . . .	21
Honorary Associate Members, .	7
Life Members, ...	301
Ordinary Members, . . .	830
	1159

Syllabus and Prizes.

The Syllabus, which was issued along with the notice calling the Annual Meeting in the beginning of last year, included 24 subjects for Essays. Eight Essays were received and submitted to the Judges, and of these six obtained awards. The Medals awarded were—One No. 1 Silver Medal, three No. 2 Silver Medals, and two Bronze Medals.

The Syllabus for 1907 was thoroughly revised by the *Transactions* Committee in the course of the year, and was issued at the close of the year along with the last part of the *Transactions*. Copies had previously been forwarded to those Members who had sent their names to the Secretary for that purpose.

Donors.

Messrs W. H. MASSIE, DAVID W. THOMSON, and JOHN METHVEN have been kind enough to renew their offers of prizes for subjects contained in the present year's Syllabus, and the Directors of the Highland and Agricultural Society have renewed the grant of £20 for prizes for home-grown timber to be exhibited in the Forestry Exhibition in their Showyard at Edinburgh. The best thanks of the Society are due to these donors for their generosity.

Honorary Editor.

Immediately after the last Annual Meeting, Dr NISBET intimated that, owing to his enforced residence in France, he was unable to continue as Honorary Editor of the *Transactions*, and asked to be relieved of the duties. He, however, said that he would be glad to contribute as usual the Continental and Indian Notes to the *Transactions*, which have been so much appreciated by Members. The Council accepted Dr Nisbet's resignation with much regret, and Colonel BAILEY, whose health has fortunately been restored, has, on the invitation of the Council, resumed the duties of Honorary Editor.

Transactions.

It was intimated at last meeting that the Council had decided to issue the *Transactions* half-yearly in future, on 1st January and 1st July. Since last Annual Meeting, therefore, three parts of the *Transactions* have been issued—one, applicable to 1905, in March, the first of the half-yearly parts as on 1st July, and the second of the half-yearly parts at the end of the year. It should be kept in mind that the *Transactions* are only issued to those Members who are not in arrear with their subscriptions. The Honorary Editor reports that he has already a large amount of material on hand for the next half-yearly part, and that he anticipates no difficulty in finding sufficient material to carry on the present arrangement successfully. On the suggestion of the Honorary Editor, the Council has approved of the appointment

of a number of *additional* Members of the *Transactions* Committee, who would not be expected to attend any meetings, but would submit suggestions and would render assistance from time to time by writing articles or notes, reviewing books, reports, or articles, and by endeavouring to induce others to send contributions.

Proposed Journal of Forestry.

Immediately after last Annual Meeting further particulars were received regarding the proposed journal of forestry referred to in last Annual Report, but, after considering the matter carefully, the Council decided to follow up the suggestion submitted at last Annual Meeting, viz., that instead of joining with the other societies in promoting a journal of forestry, this Society should issue its own *Transactions* half-yearly, with the view of ultimately developing the publication into a quarterly if required.

Local Branches.

As was reported at the General Meeting held at Peebles, a Branch of the Society was inaugurated at Aberdeen in May last. The rules of the Branch have been submitted to and approved by the Council, and have been signed by the President and the Secretary. A report from the Aberdeen Branch has been received, and will be submitted to the meeting. A requisition has also been received from a number of Members residing in the Inverness district, and the Council has decided to hold a meeting in Inverness on an early date, when a Branch will be formed there.

Deputation to the Chancellor of the Exchequer.

It will be remembered that at last Annual Meeting a suggestion was made by Mr Munro Ferguson that a deputation from the Society should be sent to the Chancellor of the Exchequer, and the matter was remitted to the President and Mr Ferguson to carry out. They accordingly arranged a meeting with Mr Asquith in London on Friday, 30th March. Sir Herbert Maxwell introduced the deputation, and the speakers on behalf of the Society were Mr Ferguson, Lord Lovat, and the President. On this occasion the English Society took part in the deputation, and was represented by the President (Professor Fisher), Mr Elwes, and others. On his return the President reported to the Council that although the Chancellor pleaded want of funds, he

was hopeful that a forest area would be provided for Scotland, and that a Forestry Department within the Board of Agriculture would be established. A detailed report of the interview was prepared by the President, and was published on page 323 of Volume XIX. of the *Transactions*.

Forestry Exhibition.

The Annual Forestry Exhibition was last year held at Peebles. The Judges' Report was printed in the proceedings of the General Meeting which was held at Peebles in the course of the Exhibition week, and a report of the Exhibition, prepared by Mr Annand, Convener of the Committee, will be found on page 87 of the last issue of the *Transactions* (Vol. XX. Part I.).

From the Judges' Report it will be seen that they awarded only £18 out of the £20 offered by the Highland and Agricultural Society, and that in addition they awarded one Gold Medal, six No. 1 Silver Medals, six No. 2 Silver Medals, and two Bronze Medals. Short lectures were delivered on each day of the Exhibition, as follows, viz.:—By Mr Annand, on "The Exhibits"; by Mr Munro Ferguson, on "The Present Position as regards Instruction in Sylviculture"; by Sir John Stirling-Maxwell, on "Hill-Planting"; and by Mr A. D. Richardson, on "The Larch Disease Fungus." These lectures have appeared or will appear in the *Transactions*. Mr Annand was kind enough to provide the necessary attendants, and special thanks are due to him for the great trouble he took in connection with the Exhibition.

A request was submitted to the Directors of the Highland and Agricultural Society that they should allow the Members of this Society special terms for admission to the Exhibition, but they replied that they could not grant any special favours to the Members of this Society without granting similar privileges to others which they had always refused.

The Exhibition is to be held in Edinburgh this year, and the Schedules have been revised and issued to the Members. The Committee are—Messrs J. W. M'Hattie (Convener), John Boyd, A. T. Gillanders, F.E.S., G. U. Macdonald, D. F. Mackenzie, F.S.I., and Adam Spiers.

The General Meeting.

The General Meeting was held last year in the Showyard of the Highland and Agricultural Society at Peebles in the course of the Exhibition week, and was well attended. The printed Minutes, which were bound up with last *Transactions*, contain a full report of the proceedings.

Excursion.

The Annual Excursion was held on 31st July and three succeeding days The party assembled at the headquarters in Newcastle on the evening of 30th July. The principal places visited were Alnwick, Lambton, Dilston, Healey, Minster Acres, and Rothbury estates, in the counties of Northumberland and Durham. The attendance was smaller than usual. A full report of the Excursion was published in the last part of the *Transactions.*

A photograph of the party was taken by Mr Richardson, the Society's photographer, at Lambton Castle, and a copy of it was published in the *Transactions.* With the view, however, of meeting the wishes of Members, it was decided to prepare enlarged copies. The photographer reports that these are almost completed, and that he expects to send out about the middle of this month all the copies that have been ordered.

The Council recommended to the General Meeting at Peebles that this year the Excursion should be held in the district of Speyside, Inverness-shire, and Ross-shire. This was approved by the meeting, and the matter was remitted to the Council, with powers. The programme has, however, not yet been sketched out.

As mentioned in last Report, the Council repeated their application to the Railway Companies to have the Society placed on the permanent list of Societies whose Members are entitled to cheap fares from any part of the country to the headquarters of the Society wherever they may be at the time of the Excursion, and the Council have pleasure in reporting that the Railway Companies have now agreed to this request. The arrangement, which permits Members to travel at the rate of a fare and a quarter for the double journey from all stations in Scotland and England, was given effect to at last Excursion.

St Louis Exhibition.

The Diploma and Medal (in bronze) awarded to the Society have now been received. The latter is in the possession of the Secretary, and the Diploma has been framed and hung up with the photographs.

New Zealand National Exhibition.

A copy of the Society's Report for 1905 was, by request, sent to the Director of the British Government Exhibits in this Exhibition.

Canadian Forestry Convention.

A copy of the Report of this Convention, which was held in the beginning of last year, has now been received, and added to the Library.

Library.

A list of additions to the Library since last Annual Meeting is appended to this Report. (See Appendix G.)

Register of Foresters.

A number of men have received appointments through the Register in the course of the year, but greater use might be made of the Register both by proprietors and estate men.

Laws.

The Laws and By-Laws have now been revised, and a proof, as approved by the Council, has been sent to all the Members of the Society. Notice will be given at this meeting of a motion to the effect that these Laws and By-Laws be adopted in place of the existing Laws and By-Laws. This motion will come up for discussion at next Annual Meeting, and, if adopted, the new Laws and By-Laws will then come into operation.

Royal Institution, Edinburgh.

It will be in the recollection of Members that about eighteen months ago representatives from this and various scientific societies having headquarters in Edinburgh, waited upon the Secretary for Scotland, and asked that the Royal Institution here might be set apart for the housing of these societies. The object desired was not then attained, as it was ultimately decided by the Government that the Royal Institution should be entirely given over to the purposes of art; but when the National Galleries Bill was recently before the House of Commons, a movement was again made by certain societies in Edinburgh with the view of securing rooms, along with the Royal Society, in any building the Government might purchase for the use of that Society in lieu of the present accommodation in the Royal Institution. The Council authorised Mr Munro Ferguson to act in the interests of this Society, and he accordingly interviewed the Secretary for Scotland in the matter. The reply he received was to the effect that it would not be

possible to consider the claims of other societies in connection with that Bill. It may therefore be concluded that the proposal that the various societies should be housed together in one Government building should be abandoned.

In these circumstances, a proposal has been made to the Council that a room—in which the Council could meet and the Society's books be kept—should be rented by the Society, and the matter is being considered by the Council.

Resolution as to Sylviculture.

In conclusion, the Council begs to submit for the approval of the meeting the following Resolution, which was unanimously passed by the Council at their meeting to-day, viz.:—

"That in the event of the Government proposing any agrarian legislation affecting Scotland, the question of Sylviculture should be considered before such legislation is introduced."

Accounts.

The Treasurer then submitted the Accounts, an Abstract of which had been printed and circulated amongst the Members, and read the Auditor's Docquet. (See Appendix A.) Mr John Methven, Convener of the Finance Committee, in moving the adoption of the Society's Accounts, expressed gratification at the continued prosperity of the Society. He pointed out that the invested funds had been increased by £230, the investments now being valued at £1518, 10s., and that the annual subscriptions had increased by £36 during the year. The Accounts were approved.

Dunn Memorial Fund Account.

The Treasurer also submitted the Accounts of the Dunn Memorial Fund, which showed a balance in hand of £12, 18s. 6d. (See Appendix B.)

Excursion Fund Accounts.

The Excursion Accounts, as audited, were then submitted by the Treasurer. These showed a balance in hand of £30, 9s. 5d. to be carried forward to next year. (See Appendix C.)

Reports from Aberdeen Branch.

The First Annual Report and Statement of Accounts received from the local Branch in Aberdeen were then read by the Secretary. (See Appendices D. and E.)

Chairman's Remarks.

The Chairman moved the adoption of the various accounts and reports, and in doing so referred briefly to the gratifying increase in the Membership, and to the satisfactory nature of the reports generally. He said that the district where it was proposed to hold the Annual Excursion during the summer was one of exceptional interest, because natural regeneration had there been carried out on a more extensive scale than anywhere else in the country. The Council proposed to hire a room in which its meetings could be held and the Society's books kept, and they hoped it would by and by develop into a house to form their headquarters. With regard to the Council's Resolution as to sylviculture, it was proposed that it should be submitted to the Secretary for Scotland, who should be urged, while considering any agrarian legislation, not to forget the claims of sylviculture, nor to bring into his Bill anything that would tend to prevent the spread of sylviculture. He returned thanks to the Society for his tenure of office, which had now come to an end. He was somewhat disappointed that the Government had not done more during his time to further the interests of forestry, but he believed that considerable progress had been made by the Society in spreading interest throughout the country. While there had been no public recognition of sylviculture in regard to forestry education, the idea of forestry was gaining ground. The people were beginning to take a certain interest in the question of forestry, and the influence of the Society was being more and more widely felt every day. He hoped that his successor, at the end of his tenure of office, would be able to report considerable progress in State forestry.

Office-Bearers.

Mr Fothringham then moved the election of Sir Kenneth J. Mackenzie, Bart. of Gairloch, as President.

Sir KENNETH MACKENZIE, having taken the chair, thanked the Meeting for the honour of electing him to the Presidentship, which he very much appreciated. He then moved a very hearty vote of thanks to Mr Fothringham for his services during the past years, and concluded by proposing the election of Mr FOTHRINGHAM and Sir THOMAS GIBSON-CARMICHAEL as Vice-Presidents. Mr FOTHRINGHAM having briefly returned thanks, the election of other Office-Bearers was proceeded with. Messrs COOK, MACDONALD, and SPIERS were re-elected Councillors, and Messrs ALLAN, FORBES, MACBEAN, and MACKINNON were elected new Members of Council. The following were re-elected:—Mr MUNRO FERGUSON, Honorary Secretary; Mr ROBERT GALLOWAY, S.S.C., Secretary and Treasurer; Colonel BAILEY, Honorary Editor; Mr A. D. RICHARDSON, Assistant Editor and Photographer; and Mr JOHN T. WATSON, Auditor.

Mr R. CAMPBELL, B.Sc., Edinburgh University, was elected Honorary Consulting Geologist in succession to Dr Flett; and the other Honorary Consulting Officials were re-elected.

The Local Secretaries were re-elected, with the addition of Mr A. E. MOERAN, Palmerston House, Portumna, Co. Galway.

The Judges and *Transactions* Committee were re-elected. (For detailed list of Office-Bearers and others see Appendix F.)

ANNUAL EXCURSION.

Mr BUCHANAN, Convener of the Excursion Committee, said that a formal programme had not yet been drawn up, but he suggested that the Excursion should be confined to Speyside, as he thought a very interesting Excursion could be carried out in that district. Sir ARCHIBALD BUCHAN HEPBURN said that the matter should be left entirely in the hands of the Council, to prepare whatever programme they thought would be most suitable, and this was agreed to.

FORESTRY EXHIBITION IN EDINBURGH.

The CHAIRMAN reminded the Members that the Schedules in connection with the Annual Forestry Exhibition had been put into their hands, and expressed the hope that as the Exhibition was to be held in Edinburgh, and was likely to be visited by the

Prince and Princess of Wales, Members would endeavour to bring forward as good a display of Forestry as possible.

Scottish National Exhibition, Edinburgh, 1908.

Mr W. H. Massie mentioned that this Exhibition was now to go on. The minimum Guarantee Fund had been exceeded, and if properly supported the Exhibition would be a success. He suggested that the Society should have an adequate representation of Forestry which would interest visitors to the Exhibition, and that the Society might subscribe to the Guarantee Fund. On the motion of the Chairman, the matter was remitted to the Council, with powers.

Motions to be Disposed of.

Mr A. B. Robertson, The Dean, Kilmarnock, submitted the following motions, of which notice was given at last Meeting, viz.:—"That the seven members of Council who retire each year be not eligible for re-election for one year from the date of their retiral." Mr R. B. Laird seconded the motion. Mr Fothringham moved the previous question. He said it might be very inconvenient if certain of the retiring Councillors were not eligible for re-election, because it might be that the Society would lose the services of some of the best men at a time when they were best able to help. Mr Gillanders seconded the amendment, which, on being put to the Meeting, was carried by a large majority. Mr Robertson then submitted his second motion, viz.:—"That the Council again consider the advisability of holding the Annual Meetings in different centres, namely, Edinburgh, Perth, and Glasgow in rotation." The motion was not seconded, and therefore was not put to the Meeting.

Notice of Motion.

The President, on behalf of the Council, gave notice of the following motion for discussion at next Annual Meeting, viz.:—"That the revised Laws and By-Laws, as sent in proof to all members of the Society, be approved and adopted in place of the existing Laws and By-Laws."

Mr Methven proposed the toast of the Magistrates, etc., which was replied to by Councillor Forrest. Mr Gulland proposed the toast of the Society, to which Mr Fothringham replied on behalf of the President, who had been obliged to leave the meeting earlier in the evening. Mr Munro Ferguson proposed the Aberdeen Branch, to which Mr Gammell replied. Other toasts were Kindred Societies, proposed by Mr Massie and replied to by Mr Macdonald; the Timber Trade, proposed by Mr Rutherford and replied to by Mr Spiers; Our Guests, proposed by Dr Borthwick and replied to by Mr Lindsay; and the Chairman, proposed by the Secretary, and replied to by Mr Fothringham.

APPENDIX A.

ABSTRACT OF ACCOUNTS for Year ending 31st December 1906.

I.—CAPITAL.

CHARGE.

1. Funds at 30th December 1905,			£1287 15 8
£500 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 117½,	£587 10 0		
£500 Caledonian Railway Company 4 per cent. Debenture Stock, at 122⅜,	613 15 0		
Balance of Capital in Bank,	86 10 8		
2. Life Members' Subscriptions in 1906,			174 6 0
New Members,	£155 8 0		
Ordinary Members by commutation,	18 18 0		
3. Sum transferred from Revenue to meet balance of price of Railway Stock purchased,			203 17 7
			£1665 19 3

DISCHARGE.

1. Proportion of Life Members' Subscriptions transferred to Revenue,			£95 14 3
Unexhausted: £716 11 0 / 79 5 1 — ⅒ of Full Life Subscriptions,	£78 11 11		
⅒ of Commuted Subscriptions,	17 2 4		
2. Price of £400 North British Railway 3 per cent. Debenture Stock, at 91¼,	£365 0 0		
3. Expenses in connection with above purchase,			4 0 0
4. Decrease in value of Railway Stocks at 31st December 1906,			47 15 0
5. Funds at 31st December 1906,			1518 10 0
£500 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 113½,	£567 10 0		
£500 Caledonian Railway Company 4 per cent. Debenture Stock, at 119,	595 0 0		
£400 North British Railway Company 3 per cent. Debenture Stock, at 89,	356 0 0		
	£1518 10 0		
			£1665 19 3

II.—REVENUE.

CHARGE.

1. Balance in hand at 30th December 1905,			£344 4 0
2. Ordinary Members' Subscriptions,			333 8 6
Arrears at 30th December 1905,	£41 15 0		
Add Arrears written off but since recovered,	1 16 0		
		£43 11 0	
Subscriptions for 1906,	£343 9 0		
Less Received in 1905,	4 16 6		
		338 12 6	
Subscriptions for 1907 received in 1906,		7 15 0	
		£389 18 6	

DISCHARGE.

1. Printing, Stationery, etc.,			£207 16 2
Vol. XIX. Part I. of *Transactions*, exclusive of Plates,	£125 17 2		
Authors' Reprints,	3 6 6		
		£129 3 8	
Vol. XIX. Part II. of *Transactions*,	£68 16 6		
Authors' Reprints,	0 11 0		
		69 7 6	
Plates, etc., for *Transactions*,		18 7 7	
		£216 18 9	
General Printing and Stationery,		25 13 10	
Forestry Periodicals, Binding, etc.,		5 3 0	

Cancelled or written off as irrecoverable at 31st December 1906,	£18 4 0		
Arrears at 31st December 1906,	38 6 0		
		56 10 0	
		£333 8 6	
3. Proportion of Life Members' Subscriptions transferred from Capital,			95 14 3
4. Dividends and Interest,			53 5 11
5. *Transactions*, etc., sold,			7 3 0
6. Income Tax Recovered,			2 0 0
			£835 15 8

Less Receipts for Advertisements in *Transactions*,		39 19 5	
		£207 16 2	
2. Prizes (Money, £21; Medals and Books, £18, 8s. 6d.),		£39 8 6	
Less Donation from the Highland and Agricultural Society, for Prizes awarded for Home-grown Timber exhibited at Peebles,		18 0 0	21 8 6
3. Forestry Exhibition at the Highland and Agricultural Society's Show at Peebles—			
Printing,	£9 13 3		
Advertising,	1 16 0		
Other Outlays,	3 18 2		
			15 7 5
4. Contribution to Funds of Aberdeen Branch,			5 0 0
5. Expenses of Management,			168 2 11
Rent,	£2 19 0		
Auditor,	3 3 0		
Assistant Editor,	25 0 0		
Secretary and Treasurer,	69 15 10		
Advertising, Insurance, and Premium on Secretary's Bond of Caution,	5 2 4		
Outlays in connection with Annual Meeting and Dinner,	4 15 0		
Postages and Miscellaneous Outlays, viz.:			
Postages of Parts I. and II. of Vol. XIX. of *Transactions*,	£23 11 0		
General Postages, Commissions on Cheques, and Petty Outlays,	33 16 9		
		57 7 9	
		£168 2 11	
6. Sum transferred to Capital to meet balance of price of Railway Stock purchased,			203 17 7
7. Balance of Revenue carried to next year (being sum in National Bank of Scotland, Limited), subject to payment of cost, etc., of January *Transactions*,			214 3 1
			£835 15 8

EDINBURGH, 23*rd January* 1907.—I hereby certify that I have examined the Accounts of the Treasurer for the year to 31st December 1906, of which

APPENDIX B.

ABSTRACT OF ACCOUNTS

IN CONNECTION WITH

THE MALCOLM DUNN MEMORIAL FUND, 1906.

RECEIPTS.

Balance in Bank at close of last Account, . .	£10	1	6
Dividend on £100 3 per cent. Redeemable Stock of Edinburgh Corporation, payable at Whitsunday and Martinmas 1906, £3, *less* Tax 3s.,	2	17	0
	£12	18	6

PAYMENTS.

Nil.

Balance carried forward, being sum in National Bank of Scotland on Account Current, ...	£12	18	6

Note.—The Capital belonging to the Fund consists of £100 3 per cent. Redeemable Stock of Edinburgh Corporation.

EDINBURGH, *26th January* 1907.—Examined and found correct. The Certificate by the Bank of above balance, and Edinburgh Corporation Stock Certificate, have been exhibited.

JOHN T. WATSON,
Auditor.

APPENDIX C.

EXCURSION FUND.

Abstract of Accounts for Year 1906.

Balance brought from last Account, . . .					£47	19 3
Received further for Photographs, . . .					0	12 0
					£48	11 3
Deduct—						
Payment to Mr Richardson, being balance for Swedish Albums, .	£3	3	0			
Payments to Mr Richardson for Benmore Photographs, . .	15	1	0			
Payment to Printers for Printing Names on Mounts, . . .	0	8	6			
Auditor's Fee for 1905, . .	2	2	0			
					20	14 6
					£27	16 9

Excursion to Northumberland and Durham.

RECEIPTS.

Contributions to Common Purse, *less* repayments, ...				£175	4	9

PAYMENTS.

Station Hotel, . .				£90	17	6
Railways – Local Journeys,				20	11	3
Lunches—						
(1) Lambton,	£7	9	9			
(2) Dipton,	7	10	0			
(3) Rothbury,	5	14	9			
				20	14	6
Driving—						
(1) Alnwick,	£5	8	0			
(2) Lambton,	4	7	6			
(3) Hexham,	6	10	6			
(4) Rothbury,	5	14	9			
				22	0	9
Teas and Refreshments, .				7	14	6
Gratuities and Sundry Outlays, ...				10	13	7
				172	12	1
					2	12 8
Balance carried forward to next year, being sum in National Bank of Scotland, Ltd., on Account Current, ...					£30	9 5

EDINBURGH, *26th January* 1907.—Examined with Vouchers and Memorandum Book and found correct. Bank Certificate of above balance of £30, 9s. 5d. also exhibited.

JOHN T. WATSON,
Auditor.

APPENDIX D.

ROYAL SCOTTISH ARBORICULTURAL SOCIETY (ABERDEEN BRANCH).

Report by the Committee of the Proceedings of the Branch to the First Annual General Meeting.

The Branch was inaugurated on the 18th May 1906, at a meeting of the Society held in the Douglas Hotel, Aberdeen, presided over by the President, Mr W. Steuart Fothringham of Murthly.

Since its inauguration the Branch has held two Excursions—one to Drumtochty on 9th June, and the other to Huntly on 1st September—and a General Meeting on 13th October.

Both the Excursions were well attended by the Members. Reports on these Excursions have been drawn up by Mr C. S. France and Mr John Clark respectively, and they will be submitted to this meeting.

At the General Meeting held in the Botanical Class-room, Marischal College, on 13th October, a paper was read by Mr C. S. France on "The Larch and its Diseases." Owing to the inclemency of the weather, the meeting was not so well attended as it otherwise would have been.

The Committee had been fortunate in securing the use of the Botanical Class-room, Marischal College, for the meetings of the Branch, and the thanks of the Branch is due to the Senatus of Aberdeen University for this privilege. The thanks of the Branch is also due to Professor Traill for the trouble taken by him in securing the use of the Class-room, and for giving the Branch the use of his diagrams, appliances, etc. In the district comprising the Branch—the counties of Aberdeen, Kincardine, and Banff—there are some 100 Members of the parent Society, but only 57 of these have, as yet, affiliated themselves to the Branch. This number does not include assistant-foresters and assistant-gardeners, of which there are eight. The Committee hopes that all Members of the parent body resident in the district will become Members of the Branch before the next Annual Meeting.

The financial statement shows the income of the Branch to be £7, 17s., which sum includes the grant of £5 from the parent Society, and the expenditure to be £4, 16s. 10d., leaving a credit balance of £3, os. 2d., which, with a balance of £1, 4s. at the credit of the Excursion Fund, brings out a total sum of £4, 4s. 2d. at the credit of the Branch, and this sum has been placed with the Aberdeen Savings Bank.

APPENDIX E.

ROYAL SCOTTISH ARBORICULTURAL SOCIETY—ABERDEEN BRANCH.

STATEMENT OF ACCOUNTS, 1906.

INCOME.

By Cash from 57 Members at 1s. each,	£2	17 0
,, Cash from Secretary of the Parent Body, Edinburgh—grant to Funds of Branch,	5	0 0
	£7	17 0

EXPENDITURE.

1906.			
May 12.	To Cash paid D. Gullan, Printer,	£0	4 0
June 14.	,, Cash paid Lewis Smith for Minute-Book,	0	3 0
,, 20.	,, Cash paid Lewis Smith for Members' Book,	0	1 6
Sept. 28.	,, Cash paid Wm. Mutch, Printer,	1	4 0
Dec. 3.	,, Cash paid Wm. Mutch, Printer,	1	13 6
	,, Cash paid postages for the year,	1	10 10
	,, Balance at credit of this Account carried to Abstract,	3	0 2
		£7	17 0

EXCURSION ACCOUNTS.

Excursion to Drumtochty on 9th June 1906.

INCOME.

By Cash from 36 Members for Lunch at 1s. 6d. each,	£2	14 0
,, Balance due on this Account carried to Abstract,	0	1 11
	£2	15 11

EXPENDITURE.

To Cash paid Reporter's Bus Fare to and from Auchinblae,	£0	1 0
,, Cash paid Thistle Hotel, Auchinblae,	0	14 6
,, Cash paid Empress Café, Aberdeen,	1	17 0
,, Cash paid Secretary's Rail and Bus Fare,	0	3 5
	£2	15 11

Excursion to Huntly on 1st September 1906.

INCOME.		EXPENDITURE.	
By Cash from 18 Members for Lunch and Driving at 3s. 6d. each,	£3 3 0	To Cash paid 6 Rail Fares at 4s. 1d. each,	£1 4 6
,, Cash from 6 Members for Lunch and Rail at 7s. 6d. each,	2 5 0	,, Cash paid Mr John Rule,	2 12 6
		,, Cash paid Secretary's Rail Fare,	0 4 1
		,, Cash paid Gratuity at Huntly,	0 1 0
		,, Balance at credit carried to Abstract,	1 5 11
	£5 8 0		£5 8 0

ABSTRACT.

Balance at credit of General Account,		£3 0 2
Balance at credit of Huntly Excursion,	£1 5 11	
Less—Debit balance on Drumtochty Excursion,	0 1 11	
		1 4 0
Balance at credit of Branch,		£4 4 2

(as per Aberdeen Savings Bank Pass Book, No. F 648.)

ABERDEEN, *6th December* 1906.—I have examined the foregoing Accounts of the Aberdeen Branch of the Royal Scottish Arboricultural Society, and have found the same correctly stated and fully vouched, the balance at the credit of the Society at the end of the year being Four pounds four shillings and twopence, which sum has been lodged in the Aberdeen Savings Bank. There are twenty-nine Members of the Society who have not yet paid their Subscriptions.

JOHN HART, *Auditor.*

APPENDIX F.

Office-Bearers for 1907:—

PRESIDENT.

Sir KENNETH J. MACKENZIE, Bart. of Gairloch, 10 Moray Place, Edinburgh.

VICE-PRESIDENTS.

Sir JOHN STIRLING-MAXWELL, Bart. of Pollok, Pollokshaws,

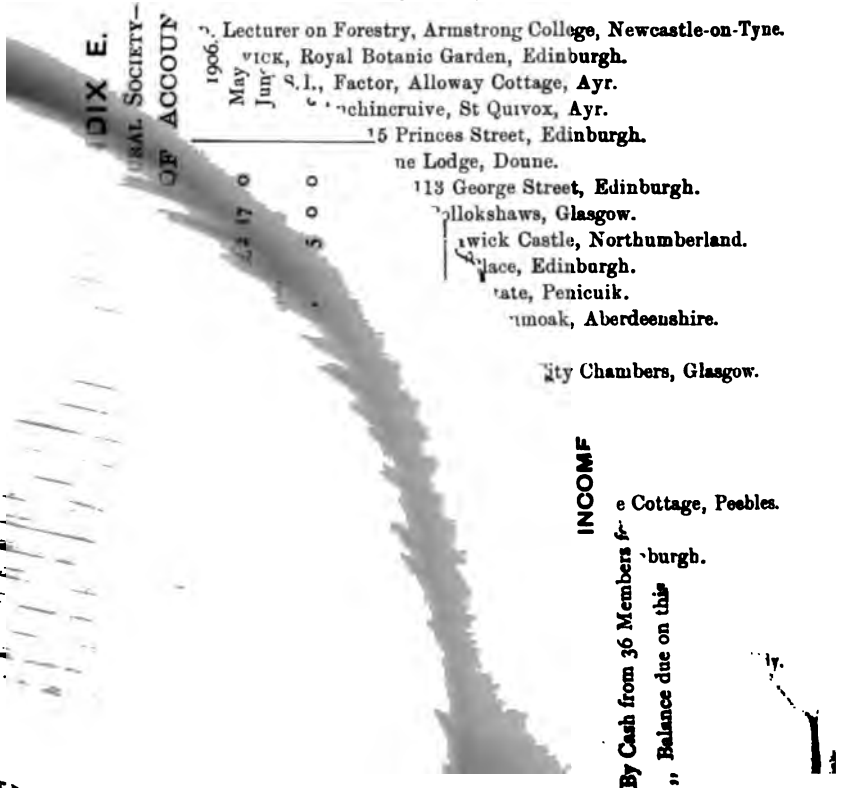
JOHN W. M'HATTIE, Superintendent of City Parks, City Chambers, Edinburgh.

D. F. MACKENZIE, F.S.I., Estate Office, Mortonhall, Midlothian.

Sir THOMAS GIBSON CARMICHAEL, Bart. of Castle Craig, Malleny House, Balerno.

W. STEUART FOTHRINGHAM of Murthly, Perthshire.

COUNCIL.



HON. EDITOR.

Colonel F. BAILEY, R.E., University Lecturer on Forestry, 7 Drummond Place, Edinburgh.

ASSISTANT EDITOR.

A. D. RICHARDSON, 6 Dalkeith Street, Joppa.

AUDITOR.

JOHN T. WATSON, 16 St Andrew Square, Edinburgh.

TRUSTEES.

R. C. MUNRO FERGUSON, M.P., W. STEUART FOTHRINGHAM of Murthly, and Sir JOHN STIRLING-MAXWELL, Bart. of Pollok.

HONORARY CONSULTING OFFICIALS

Consulting Botanist.—ISAAC BAYLEY BALFOUR, LL.D., M.D., Sc.D., Professor of Botany, University of Edinburgh, and Regius Keeper, Royal Botanic Garden, Edinburgh.

Consulting Chemist.—ALEXANDER LAUDER, D.Sc., F.C.S., 13 George Square, Edinburgh.

Consulting Cryptogamist.—A. W. BORTHWICK, D.Sc., Royal Botanic Garden, Edinburgh.

Consulting Entomologist.—ROBERT STEWART MACDOUGALL, M.A., D.Sc., Professor of Entomology, etc., 13 Archibald Place, Edinburgh.

Consulting Geologist.—R. CAMPBELL, M.A., B.Sc., Geological Laboratory, University of Edinburgh.

Consulting Meteorologist.—ROBERT COCKBURN MOSSMAN, F.R.S.E., F.R.Met.Soc., 10 Blacket Place, Edinburgh.

JUDGES AND TRANSACTIONS COMMITTEE.

Colonel F. BAILEY, Lecturer on Forestry, University of Edinburgh (*Convener*).
D. F. MACKENZIE, F.S.I., Estate Office, Mortonhall, Midlothian.
JOHN ANNAND, Lecturer on Forestry, Armstrong College, Newcastle-on-Tyne.
A. T. GILLANDERS, F.E.S., Forester, Alnwick Castle, Northumberland.
Dr A. W. BORTHWICK, Royal Botanic Garden, Edinburgh; and
The SECRETARY, *ex officio*.

PHOTOGRAPHIC ARTIST.

A. D. RICHARDSON, 6 Dalkeith Street, Joppa.

LOCAL SECRETARIES.

Scotland.

Counties.	
Aberdeen,	JOHN CLARK, Forester, Haddo House, Aberdeen.
	JOHN MICHIE, M.V.O., Factor, Balmoral, Ballater.
Argyle,	JOHN D. SUTHERLAND, Estate Agent, Oban.
Ayr,	ANDREW D. PAGE, Overseer, Culzean, Maybole.
	A. B. ROBERTSON, Forester, The Dean, Kilmarnock.
Berwick,	WM. MILNE, Foulden Newton, Berwick-on-Tweed.
Bute,	WM. INGLIS, Forester, Cladoch, Brodick.
	JAMES KAY, Forester, Bute Estate, Rothesay.
Clackmannan,	ROBERT FORBES, Estate Office, Kennet, Alloa.
Dumbarton,	ROBERT BROWN, Forester, Boiden, Luss.
Dumfries,	D. CRABBE, Forester, Byreburnfoot, Canonbie.
	JOHN HAYES, Dormont Grange, Lockerbie.
East Lothian,	W. S. CURR, Factor, Ninewar, Prestonkirk.
Fife,	WM. GILCHRIST, Forester, Nursery Cottage, Mount Melville, St Andrews.
	EDMUND SANG, Nurseryman, Kirkcaldy.
Forfar,	JAMES CRABBE, Forester, Glamis.
	JAMES ROBERTSON, Forester, Panmure, Carnoustie.
Inverness,	JAMES A. GOSSIP, Nurseryman, Inverness.
Kincardine,	JOHN HART, Estates Office, Cowie, Stonehaven.
Kinross,	JAMES TERRIS, Factor, Dullomuir, Blairadam.
Lanark,	JOHN DAVIDSON, Forester, Dalzell, Motherwell.
	JAMES WHITTON, Superintendent of Parks, City Chambers, Glasgow.
Moray,	JOHN BRYDON, Forester, Rothes, Elgin.
	D. SCOTT, Forester, Darnaway Castle, Forres.
Perth,	W. HARROWER, Forester, Tomnacroich, Garth, Aberfeldy.
	JOHN SCRIMGEOUR, Doune Lodge, Doune.
Renfrew,	S. MACBEAN, Overseer, Erskine, Glasgow.
Ross,	JOHN J. R. MEIKLEJOHN, Factor, Novar, Evanton.
	Miss AMY FRANCES YULE, Tarradale House, Muir of Ord.
Roxburgh,	JOHN LEISHMAN, Manager, Cavers Estate, Hawick.
	R. V. MATHER, Nurseryman, Kelso.
Sutherland,	DONALD ROBERTSON, Forester, Dunrobin, Golspie.
Wigtown,	JAMES HOGARTH, Forester, Culhorn, Stranraer.
	H. H. WALKER, Monreith Estate Office, Whauphill.

England.

Counties.	
Beds, . .	JOHN ALEXANDER, 46 Clarendon Road, Bedford.
	FRANCIS MITCHELL, Forester, Woburn.
Berks, . .	W. STORIE, Whitway House, Newbury.
Cheshire, .	WM. A. FORSTER, Belgrave Lodge, Pulford, Wrexham.
Devon, . .	JAMES BARRIE, Forester, Stevenstone Estate, Torrington.
Durham, .	JOHN F. ANNAND, Lecturer on Forestry, Armstrong College, Newcastle-on-Tyne.
Hants, . .	W. R. BROWN, Forester, Park Cottage, Heckfield, Winchfield.
Herts, . .	JAMES BARTON, Forester, Hatfield.
	THOMAS SMITH, Overseer, Tring Park, Wigginton, Tring.
Kent, . .	R. W. COWPER, Gortanore, Sittingbourne.
Lancashire, .	D. C. HAMILTON, Forester, Knowsley, Prescot.
Leicester, .	JAMES MARTIN, The Reservoir, Knipton, Grantham.
Lincoln, .	W. B. HAVELOCK, The Nurseries, Brocklesby Park.
Middlesex, .	Professor BOULGER, 11 Onslow Road, Richmond Hill, London, S.W.
Northumberland,	JOHN DAVIDSON, *Secretary*, Royal English Arboricultural Society, Haydon-Bridge-on-Tyne.
Notts, . .	WM. ELDER, Thoresby, Allerton, Newark.
	W. MICHIE, Forester, Welbeck, Worksop.
	WILSON TOMLINSON, Forester, Clumber Park, Worksop.
Salop, . .	FRANK HULL, Forester, Lilliesshall, Newport.
Suffolk, . .	ANDREW BOA, Agent, Skates Hill, Glemsford.
	GEORGE HANNAH, The Folly, Ampton Park, Bury St Edmunds.
Surrey, . .	ANDREW PEEBLES, Estate Office, Albury, Guildford.
Warwick, .	A. D. CHRISTIE, Marriage Hill Farm, Bidford.
York, . .	D. TAIT, Estate Bailiff, Owston Park, Doncaster.

Ireland.

Dublin, . .	A. C. FORBES, Department of Forestry, Board of Agriculture.
	JAMES WILSON, B.Sc., Royal College of Science, Dublin.
Galway, . .	ARCH. E. MOERAN, Palmerston House, Portumna.
	THOMAS ROBERTSON, Forester and Bailiff, Woodlawn.
Kilkenny, .	ALEX. M'RAE, Forester, Castlecomer.
King's County,	WM. HENDERSON, Forester, Clonad Cottage, Tullamore.
Tipperary, .	DAVID G. CROSS, Forester, Kylisk, Nenagh.

APPENDIX G.

Presentations to the Society's Library since the publication of last List in Volume XIX. Part 2.

Books.

1. Schlich's *Manual of Forestry*. Vol. i. of 3rd Edition.
2. ,, ,, ,, Vol. iv. of 2nd Edition—*Forest Protection*. By Prof. W. R. Fisher.
3. *Forest Mensuration*. By H. S. Graves, M.A., Director of the Forest School, Yale University.
4. *Fremländische Wald-und Parkbäume für Europa*. By Professor Heinrich Mayr, 1906.
5. *The Country Gentlemen's Estate Book*, 1906.
6. *The New Zealand Official Year-Book*, 1905.
7. *Report of the Canadian Forestry Convention*, 1906.
8. Kew Gardens. Bulletins for Years 1900 to 1906.

Societies' Reports, Transactions, Etc.

9. *Transactions of the Highland and Agricultural Society*, 5th Series, vol. xviii.
10. *Transactions of the Royal English Arboricultural Society*, vol. vi., part 2.
11. *Transactions and Proceedings of the Botanical Society of Edinburgh*, vol. xxiii., part 2.
12. *Scientific Transactions of the Royal Dublin Society*, vol. ix. (Series 2), Nos. 2 and 3.
13. *Scientific Proceedings of the Royal Dublin Society*, vol. xi., Nos. 6, 7, 8, 9, 10, 11, and 12.
14. *Economic Proceedings of the Royal Dublin Society*, vol. i., parts 7 and 8.
15. *Transactions of the Massachusetts Horticultural Society*, 1905, part 2; 1906, part 1.
16. *The 84th Report of the Commissioners of Woods, Forests, and Land Revenues*, 28th June 1906.
17. *Annual Report of Forest Department, Madras*, 1904-05, and 1905-06.
18. *Annual Report of Secretary for Agriculture, Nova Scotia*, 1905.
19. *Annual Report of State Forest Administration, South Australia*, 1904-05, and 1905-06.
20. *Report of the Superintendent of Forestry of Canada*, part x., 1905.
21. *Report of the Department of Lands and Survey, New Zealand*, 1904-05.

22. *First Annual Report of the Land Board, Natal*, 1906.
23. *Journal of the Royal Agricultural Society*, vol. lxvi., 1905.
24. *Journal of the Royal Horticultural Society*, April 1906 and December 1906.
25. *Calendar for* 1906-07—*Edinburgh and East of Scotland College of Agriculture.*
26. *Calendar* 1905-06—*University College of North Wales.*
27. *Ohio State University Catalogue and Announcements, etc.*
28. *Prospectus of Yale Forest School*, 1906-07.
29. *Mycological Notes*, Nos. 19 to 23. By C. G. Lloyd.
30. *Index to Mycological Writings of C. G. Lloyd*, vol. i., 1898 to 1905.
31. *The Tylostomeæ.* By C. G. Lloyd.
32. Several Volumes (in parts) of the Society's *Transactions.* From James Robertson, Wood Manager, Panmure.

Reprints, Etc.

33. *Working-Plan of Castle Hill Woodlands.* By Professor W. R. Fisher, President, Royal English Arboricultural Society.
34. *Report by the British Juror on Horticulture and Forestry, St Louis International Exhibition*, 1904.
35. Forest Bulletin No. 7. *Note on the Chilyoze Forests of Zhole and the Takht-I-Suliman.* By E. P. Stebbing, F.L.S.
36. Forest Bulletin No. 9. *Notes on the Influence of Forests on the Storage and Regulations of the Water Supply.* By S. Eardley-Wilmot, Indian Forest Service.
37. *Review of Forest Administration in British India*, Year 1904-05. By S. Eardley-Wilmot, Inspector-General of Forests.
38. *Note on the Life-History of Hoplocerambyx spinicornis.* By E. P. Stebbing, F.L.S.
39. *Notes sur la Truffe par M. Em. Boulanger*, 1904-1906.
40. *Les Forêts et les Pluies.* By Professor Henry, Nancy.
41. *La Forêt Accumulatrice D'Azote.* By Professor Henry, Nancy.
42. *Congres des Forestiers Suisses sur les Rives du Léman En*, 1906. Reprint by P. Bertholet.
43. *Species of Crataegus found within* 20 *miles of Albany.* By C. S. Sargent and C. H. Peck, 1906.
44. *The Pinetum at Wellesley, Mass.* By C. S. Sargent.
45. *Catalogue of the Aburi Gardens.* From University Institute of Commercial Research in the Tropics, Liverpool.
46. *Quarterly Journal of the Institute of Commercial Research in the Tropics*, Liverpool University, vol. i., No. 2, April 1906; No. 3, September 1906.
47. *Year-Book of Agriculture, Victoria*, 1905.
48. *Journal of the Board of Agriculture, Victoria.*
49. *Evidence of Various Experts before Select Standing Committee on Agriculture and Colonisation, Canada*, 1905.
50. Bulletin 53. *Results from Trial Plots of Grain, Roots, etc.*, 1905. From Central Experimental Farm, Ottawa.

Royal Scottish Arboricultural Society.

(INSTITUTED 16th FEBRUARY 1854.)

LIST OF MEMBERS &c.,

As at December 1906.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING.

PRESIDENT.

W. STEUART FOTHRINGHAM of Murthly, Perthshire.

FORMER PRESIDENTS.

YEAR.	
1854–56.	JAMES BROWN, { Deputy-Surveyor of the Royal Forest of Dean. Wood Commissioner to the Earl of Seafield.
1857.	The Right Hon. THE EARL OF DUCIE.
1858.	The Right Hon. THE EARL OF STAIR.
1859.	Sir JOHN HALL, Bart. of Dunglass.
1860.	His Grace THE DUKE of ATHOLL.
1861.	JOHN I. CHALMERS of Aldbar.
1862.	The Right Hon. THE EARL OF AIRLIE.
1863.	The Right Hon. T. F. KENNEDY.
1864–71.	ROBERT HUTCHISON of Carlowrie, F.R.S.E.
1872–73.	HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1874–75.	JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS. L. & E., Professor of Botany in the University of Edinburgh.
1876–78.	The Right Hon. W. P. ADAM of Blairadam, M.P.
1879–81.	The Most Hon. THE MARQUESS OF LOTHIAN, K.T.
1882.	ALEXANDER DICKSON, M.D., F.R.S.E., of Hartree, Regius Professor of Botany in the University of Edinburgh.
1883–85.	HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1886–87.	The Right Hon. Sir HERBERT EUSTACE MAXWELL, Bart. of Monreith.
1888–89.	The Right Hon. THE MARQUESS OF LINLITHGOW, Hopetoun House, South Queensferry.
1890–93.	ISAAC BAYLEY BALFOUR, M.D., Sc.D., F.R.S., Professor of Botany in the University of Edinburgh.
1894–97.	R. C. MUNRO FERGUSON, M.P.
1898.	Colonel F. BAILEY, R.E.
1899–92.	The Right Hon. THE EARL OF MANSFIELD.
1903–	W. STEUART FOTHRINGHAM of Murthly.

LIFE AND ORDINARY MEMBERS.

* *Indicates Life Member.* *Italics indicates that present Address is unknown.*

LAW V. Members in arrear shall not receive the *Transactions* while their Subscriptions remain unpaid. Any Member whose Annual Subscription to the Society remains unpaid for three years shall cease to be a Member of the Society, and no such Member shall be eligible for re-election till he shall have paid up his arrears.

Date of Election.

1895. ABBOT, Thomas, Forester, Neidpath Castle, Peebles.
*1906. ABERCROMBY, Sir George William, Forglen, Turriff.
1904. ABERNETHY, Thomas, Assistant Forester, White Deer Lodge, Welbeck Park, Worksop.
1902. ACLAND, Sir Charles Thomas Dyke, Bart., M.A., D.L., etc., Killerton, Exeter.
*1900. ADAIR, David Rattray, S.S.C., 19 Castle Street, Edinburgh.
*1883. ADAM, Sir Charles Elphinstone, Bart. of Blairadam, 5 New Square, Lincoln's Inn, London, W.C.
*1904. ADAMS, Joseph Wm. Atkin, Resident Agent, Mill Hill, Middlesex.
1906. ADAMSON, John, Assistant Forester, Chatsworth, Pilsley, Bakewell.
*1874. ADDINGTON, The Right Hon. Lord, Addington Manor, Winslow, Bucks.
*1904. AGNEW, Sir Andrew, Bart., Lochnaw Castle, Stranraer.
1903. AILSA, The Marquess of, Culzean Castle, Maybole.
1906. AINSLIE, John, Factor, Stobo, Peeblesshire.
1902. AINSLIE, Thomas, Glenesk, Penicuik.
1902. AITCHISON, William, Assistant Forester, Weirburn Cottage, Grant's House.
1905. ALEXANDER, Henry, Head Forester, Grimstone Estate, Gilling East, York.
*1883. ALEXANDER, John, 46 Clarendon Road, Bedford.
1903. ALLAN, James, Wood Merchant, Bucksburn.
1905. ALLAN, James, Forester, Lyde Green, Rotherwick, Winchfield, Hants.
*1903. ALLAN, Robert, Factor, Halfway House, Polkemmet, Whitburn.
1898. ALLAWAY, William, 13 St Andrew Square, Edinburgh.
1905. *Anderson, Duncan, Assistant Forester, Pierremont Nurseries, Darlington.*
1905. *Anderson, George, Forester, Bawdsey Manor, Woodbridge, Suffolk.*
*1901. ANDERSON, Robert, Bailiff, Phœnix Park, Dublin.
1906. ANDERSON, Robert, Assistant Forester, Fairnington, Roxburgh.
1887. ANNAND, John F., Lecturer on Forestry, Armstrong College, Newcastle-on-Tyne.
1903. ANSTRUTHER, Sir Ralph, Bart. of Balcaskie, Pittenweem.
1903. ARCHIBALD, John Clark, Head Forester, Eden Hall, Langwathby R.S.O., Cumberland.
1903. *Archibald, W. F. B., Forester, Whitehill, Bothwell.*

Date of Election.

1903. BENTINCK, Lord Henry, M.P., Underley Hall, Kirkby Lonsdale.
1904. BERRY, Charles Walter, B.A., 11 Atholl Crescent, Edinburgh
1889. BERRY, Francis, Forester, Minto, Hawick.
1903. BEVERIDGE, Erskine, LL.D., of Brucefield, St Leonard's Hill, Dunfermline.
1903. BINNING, The Lord, Mellerstain, Kelso.
1889. *Bissett, Alexander, Forester, Tregothnan, Truro.*
*1897. BLACK, Alexander, The Gardens, Carton, Maynooth, Co. Kildare.
1904. BLACK, John, Factor, Cortachy Castle, Kirriemuir.
1903. BLAIR, Thomas, Farmer, Hoprig Mains, Gladsmuir.
1872. BOA, Andrew, Estate Agent, Great Thurlow, Suffolk.
*1877. BOLCKOW, C. F. H., of Brackenhoe, Marton Hall, Marton R.S.O., Yorks.
1892. BOND, Thomas, Forester, Lambton Park, Fence Houses, Durham.
*1895. BOORD, W. Bertram, Land Agent, Bewerley, Pateley Bridge, Yorks.
1876. BOOTH, John, 39 Mozartstrasse Gross-Lichterfelde, Berlin.
*1898. BORTHWICK, Albert W., D.Sc., Royal Botanic Garden, Edinburgh.
1898. BORTHWICK, Francis J. G., W.S., 9 Hill Street, Edinburgh.
1887. BOULGER, Professor, 11 Onslow Road, Richmond Hill, London, S.W.
1896. BOWLES, William A., The Gardens, Adare Manor, Adare, Co. Limerick.
1906. BOWMAN, John, Assistant Forester, Kincluny, Durris, Aberdeen.
1883. BOYD, John, Forester, Wood Cottage, Kennishead, Thornliebank.
1897. BRAID, J. B., Forester, Witley Court, Great Witley, Stourport.
*1899. BRAID, Thomas, Factor, Durris, Drumoak, Aberdeenshire.
*1902. BRAID, William Wilson, Tossville, 12 Milton Road, Craigmillar Park, Edinburgh.
1906. BREMNER, John, Estate Clerk of Works, Durris, Aberdeen.
*1900. BROOM, John, Wood Merchant, Bathgate.
1905. *Brown, Alexander Shannon, Assistant Forester, 17 Henrietta Street, Kilmarnock.*
*1900. BROWN, Charles, Factor, Kerse, Falkirk.
1904. BROWN, George, Timber Merchant, Buckhaven Saw-mills, Buckhaven.
1905. BROWN, George H., Assistant Forester, Ramsden Farm, Brimscall, Chorley, Lancashire.
1900. BROWN, Gilbert, Assistant Forester, Beaufort Cottage, Kiltarlity.
1878. BROWN, J. A. Harvie-, of Quarter, Dunipace House, Larbert.
1904. *Brown, James, Forester, Burnside Cottage, Houston.*
1899. BROWN, John, C.A., 10 Royal Exchange, Edinburgh.
1899. BROWN, John, Forester and Ground Officer, Craighall, Rattray, Perthshire.
1893. BROWN, Robert, Forester, Boiden, Luss.
*1896. BROWN, Rev. W. Wallace, Minister of Alness, Ross-shire.
1895. BROWN, Walter R., Forester, Park Cottage, Heckfield, near Winchfield, Hants.
1900. BROWN, William, Forester, Lissadell, Sligo, Ireland.
1905. BRUCE, Alexander, Timber Merchant, 53 Bothwell Street, Glasgow.
1901. BRUCE, David, Forester, The Square, Dunnottar, Stonehaven.
*1895. BRUCE, Peter, Manager, Achnacloich, Culnadalloch, by Connel.

Date of Election.

*1903. CAPEL, James Carnegy, 34 Roland Gardens, London, S.W.
*1896. CARMICHAEL, Sir Thos. D. Gibson, Bart. of Castlecraig, Malleny House, Balerno.
1906. CARNEGIE, James, of Stronvar, Balquhidder.
1903. CARRUTHERS, Major Francis John, of Dormont, Lockerbie.
*1898. CARSON, David Simpson, C.A., 209 West George Street, Glasgow.
1904. CATHCART, Sir Reginald Gordon, Bart., Cluny Castle, Aberdeenshire.
1904. CAVERS, A. R. S., Estate Office, Benmore, Kilmun.
1900. CAVERS, Walter, Timber Merchant, 12 East Brighton Crescent, Portobello.
1904. CHADWICK, Robert, Findhorn House, Forres.
*1906. CHALCRAFT, George Barker, C.E., M.Inst.C.E., Cross Grove House, Totley, near Sheffield.
1897. CHALMERS, James, Overseer, Gask, Auchterarder, Perthshire.
1898. CHALMERS, James, Forester, Ayton House, Abernethy.
1904. CHALMERS, Robert W., Assistant Forester, The Mains, Dundas Castle, South Queensferry.
1892. CHAPMAN, Andrew, Factor, Dinwoodie Lodge, Lockerbie, Dumfriesshire.
1892. CHAPMAN, Mungo, Torbrix Nurseries, St Ninians, Stirling.
1906. CHISHOLM, Alexander M'Kenzie, Clerk of Works, Dalkeith Park, Dalkeith.
1897. CHISHOLM, Colin, Forester, Lundin and Montrave Estates, Hattonlaw, Lundin Links.
*1882. CHOWLER, Christopher, Gamekeeper, Dalkeith Park; Dalkeith.
1884. CHRISTIE, Alex. D., Marriage Hill Farm, Bidford, Warwickshire.
1906. CHRISTIE, Charles, Factor, Estate Office, Strathdon.
1906. CHRISTIE, Thomas, Nurseryman, Rosefield Nurseries, Forres.
*1883. CHRISTIE, William, Nurseryman, Fochabers.
1890. CLARK, Charles, Forester, Cawdor Castle, Nairn.
1902. CLARK, Francis Ion, Estate Office, Haddo House, Aberdeen.
1891. CLARK, John, Forester, Haddo House, Aberdeen.
1892. *Clark, John, jun., Forester, Bawdsey, Woodbridge, Suffolk.*
1906. CLARK, John, Assistant Forester, Montrave, Hattonlaw, Lundin Links.
1892. CLARK, William, 66 Queen Street, Edinburgh.
1902. CLARK, William, Assistant Factor, Raith, Kirkcaldy.
*1872. CLERK, Sir George D., Bart. of Penicuik, Midlothian.
*1902. CLINTON, The Right Hon. Lord, Fettercairn House, Fettercairn.
1906. CLYNE, James, Engineer, Knappach, Banchory.
*1898. COATS, Sir Thomas Glen, Bart., Ferguslie Park, Paisley.
1904. COBB, Herbert Mansfield, Land Agent, Higham, Rochester, Kent.
1896. *Cockburn, Alex. K., Assistant Forester, 51 High Street, Peebles.*
1906. COCKER, Alexander Morrison, Nurseryman, Sunnypark Nursery, Aberdeen.
*1904. COKE, Hon. Richard, Holkham, Norfolk.
1906. COLEBROOKE, Lord, Glengonnar, Abington, Lanarkshire.
1906. COLES, Walter G., Engineer, 122 George Street, Edinburgh.
1900. COLLIE, Alexander, Head Forester, Cholmondeley, Malpas, Cheshire.

Date of Election.

1904. DAINE, Herbert Simpson, M.R.A.S.E., F.H.A.S., Woodfall Hall Farm, Huyton, Liverpool.
*1867. DALGLEISH, John G., of Arduamurchan, Brankston Grange, Stirling.
*1876. DALGLEISH, Laurence, of Dalbeath, Rutland Square, Edinburgh.
*1906. DALGLEISH, Sir William Ogilvie, Bart., Errol Park, Errol.
*1900. DALHOUSIE, The Right Hon. the Earl of, Brechin Castle, Forfarshire.
1901. DALRYMPLE, Hon. Hew H., Lochinch, Castle Kennedy, Wigtownshire.
*1906. DALRYMPLE, Lord, M.P., Lochinch, Stranraer.
1904. DALRYMPLE, The Right Hon. Sir Charles, Bart. of Newhailes, Musselburgh.
1884. DALZIEL, James, Forester, Culzean Castle, Maybole, Ayrshire.
1905. DAVID, Albert E., Assistant Forester, Bowood, Calne, Wilts.
1905 DAVID, William J., Assistant Forester, Heckfield, Winchfield, Hants.
1904. DAVIDSON, James, 12 South Charlotte Street, Edinburgh.
1865. DAVIDSON, John, Agent, Greenwich Hospital Estates, Haydon Bridge-on-Tyne.
1892. DAVIDSON, John, Forester, Dalzell, Motherwell, Lanarkshire.
*1892. DAVIDSON, William, Forester, Margam Park, Port Talbot, Wales.
1901. DAVIE, George, Overseer, Balruddery Gardens, near Dundee.
1904. DAVIE, Thomas, Assistant Forester, c/o Mrs M'Pherson, Fortingall, Aberfeldy.
1906. DAWSON, Herbert Thompson, The Nurseries, Knowsley.
1904. DENHOLM, John, Timber Merchant, Bo'ness.
1906. DENTON, Sydney, Assistant Forester, Bowood, near Calne, Wilts.
1906. DEWAR, Alex., Factor, Fasque Estates Office, Fettercairn.
1902. DEWAR, H. R., Forester, Beaufort Castle, Beauly.
*1901. DEWAR, John A., M.P., Perth.
1904. DEWAR, Robert, Assistant Forester, Bowmont Forest, Roxburgh.
1905. *Dewar, William, Assistant Forester, Fauldsley, Halliburton, Coupar-Angus.*
1904. DICK, William, Timber Merchant, Hamilton.
*1898. DIGBY, The Right Hon Baron, Minterne, Cerne, Dorsetshire.
1904. DODDS, Thomas, Cashier, Pollok Estate Office, 216 West George Street, Glasgow.
*1903. DON, Alex., Namitomba Estate, Zomba, British Central Africa.
1901. DONALD, James Alexander, Assistant Forester, Cluny Square, Cardenden, Fife.
1893. DONALDSON, James, Timber Merchant, Tayport, Fife.
*1896. DOUGLAS, Alex., Abbey Gardens, Wykeham R.S.O., Yorks.
1882. DOUGLAS, Captain Palmer, of Cavers, Hawick.
1904. DOUGLAS, James A., Assistant Forester, Ardgowan, Inverkip.
1887. DOUGLAS, Robert, 64 Princes Street, Edinburgh.
1903. DOUGLAS, William G., Assistant Forester, Margam, Port Talbot, Wales.
1903. DOW, Alexander, Forester, Bretby Park, Burton-on-Trent.
1898. DOW, Thomas, Forester, Wakefield Lawn, Stony Stratford, Bucks.
1904. DRUMMIE, Alexander, Assistant Forester, c/o Mr I. Embleton, Linolds Wood Cottage, Hexham, Northumberland.

Date of Election.

1898. FARQUHARSON, Dr Robert, of Finzean, Aboyne, Aberdeenshire; Migvie Lodge, Porchester Gardens, London, W.
1899. FAWCETT, Thos. G., Land Agent, Yarm-on-Tees.
1900. FEAKS, Matthew, Forester, Benmore, Kilmun.
1904. FENWICK, Andrew, Assistant Forester, Kinnaird Mill, Brechin.
1903. FENWICK, William, Factor, Rockdale, Kinfauns, Perth.
*1900. FERGUSON, James Alex., Ardnith, Partickhill, Glasgow.
1899. FERGUSON, J. E. Johnson, M.P., of Springkell, Ecclefechan.
*1888. FERGUSON, R. C. Munro, M.P., of Raith and Novar, Raith, Fife.
1880. FERGUSSON, Sir James Ranken, Bart., Spitalhaugh, West Linton.
*1901. FINDLAY, John Ritchie, of Aberlour, Aberlour House, Aberlour.
1893. FINLAYSON, Alexander, Hardengreen, Eskbank.
1893. FINLAYSON, Malcolm, Solicitor, Crieff, Perthshire.
1869. FISHER, William, Estate Agent, Wentworth Castle, Barnsley, Yorkshire.
1899. FISHER, W. R., Assistant Professor of Forestry, Oxford University.
*1902. FITZWILLIAM, Right Hon. the Earl of, Wentworth, Rotherham.
1899. FLEMING, John, Timber Merchant, Albert Saw-mills, Aberdeen.
1906. FLETCHER, J. Douglas, of Rosehaugh, Avoch, Ross-shire.
1890. FORBES, Arthur C., Department of Agriculture, Dublin.
1898. FORBES, James, Factor, Blair Castle, Blair Atholl.
*1896. FORBES, James, The Gardens, Overtoun, Dumbartonshire.
*1878. FORBES, Robert, Estate Office, Kennet, Alloa.
1904. FORBES, Robert Guthrie, jun., Forester, Cliff House, Gulworthy, Tavistock, Devon.
*1873. FORBES, William, Consulting Forester, 11 Dale Street, Liverpool.
1891. FOREMAN, Frederick, Nurseryman, Eskbank, Dalkeith.
1892. FORGAN, James, Sunnybraes, Largo, Fife.
*1869. FORGAN, James, Forester, Bonskeid, Pitlochry, Perthshire.
1889. FORSTER, William A., Forester, Belgrave Lodge, Pulford, Wrexham.
1904. FOSTER, Henry, Assistant Forester, Glenalmond, Methven.
1898. FOSTER, James, jun., Kennet Village, Alloa.
*1897. FOTHRINGHAM, W. Steuart, of Murthly, Perthshire.
*1866. FRANCE, Charles S., 7 Belmont Place, Aberdeen.
*1901. FRASER, Alexander, Solicitor and Factor, 63 Church Street, Inverness.
1900. FRASER, Alexander, Factor, Lundin and Montrave Estates Office, Leven.
*1892. FRASER, George, Factor, Dalzell, Motherwell, Lanarkshire.
1898. FRASER, James, Assistant Forester, 10 Woodside Walk, Hamilton.
*1899. FRASER, James, Home Steward, Tregothnan, Truro.
1895. FRASER, J. C., Nurseryman, Comely Bank, Edinburgh.
1905. FRASER, John, Forester, 121 Latimer Road, Eastbourne, Sussex.
1901. FRASER, John M'Laren, of Invermay, Forgandenny, Perthshire.
1904. FRASER, Peter, Land Steward, Dalguise, Dunkeld.
1904. FRASER, Robert A., Cab Proprietor, 3 Sunbury Street, Edinburgh.
*1892. FRASER, Simon, Land Agent, Hutton in the Forest, Penrith.

Date of Election.

1904. GRANT, Ewan S., Assistant Forester, c/o Mrs Barnes, Edensor, Bakewell, Derbyshire.
*1874. GRANT, John, Overseer, Daldowie, Tollcross, Glasgow.
1893. GRANT, John B., Forester, Downan House, Glenlivet.
1893. GRANT, Peter, Land Steward, Kilmeade Farm, Athy, Co. Kildare.
1880. GRANT, Sir George Macpherson, Bart., Ballindalloch Castle, Banffshire.
1906. GRASSICK, William Henderson, Land Steward, Daviot Branch Asylum, Pitcaple, Aberdeenshire.
1906. GRAY, David, Wheelwright, 270 Great Western Road, Aberdeen.
1903. GRAY, Hon. Morton G. Stuart, of Kinfauns, Perth.
1901. GRAY, Major William Anstruther-, of Kilmany, Cupar, Fife.
1902. GRAY, Robert, Timber Merchant, Fraserburgh.
1902. GRAY, Walter Oliver, Foreman Woodman, North Lodge, Minto.
1902. GREIG, Hugh Gorrie, Coltness Estate Office, Wishaw.
1906. GREIG, Robert Blyth, F.H.A.S., F.R.S.E., Marischal College, Aberdeen.
1904. GRENFELL, Arthur Pascoe, Cossington, Bridgwater.
1898. GREY, The Right Hon. Sir Edward, Bart., M.P., of Falloden, Chathill, Northumberland.
1903. GRIFFITHS, Sir Richard Waldie, of Hendersyde Park, Kelso.
*1905. GURNEY, Eustace, Sprowston Hall, Norwich.

1879. HADDINGTON, The Right Hon. the Earl of, K.T., Tyninghame, Prestonkirk.
1880. HADDON, Walter, Solicitor, Royal Bank, Hawick.
*1900. HALDANE, William S., of Foswell, W.S., 55 Melville Street, Edinburgh.
1905. HALL, Thomas, Forester, Moore Abbey, Monasterevan, Co. Kildare.
1906. HALL, William, Head Forester, Tockwith, near York.
1904. HALLEY, John Y. (of Garvie & Syme), Ironmonger, etc., Perth.
1897. HALLIDAY, Geo., Timber Merchant, Rothesay.
1901. HALLIDAY, John, Timber Merchant, Rothesay.
*1882. HAMILTON, Donald C., Forester, Knowsley, Prescot.
*1899. HAMILTON, The Right Hon. Baron, of Dalzell, Dalzell House, Motherwell.
1899. *Hamilton, James, The Gardens, Manderston, Duns.*
1897. HAMILTON-OGILVY, H. T. M., of Beil, Prestonkirk, East Lothian.
1904. HANCOCK, Charles, M.A., Barrister-at-Law, Firlands, Grayshott, Hants; 125 Queen's Gate, London, S.W.
1892. HANNAH, George, Overseer, The Folly, Ampton Park, Bury St Edmunds, Suffolk.
1903. HANNAH, Thomas, Forester, Rendelsham Park, Woodbridge, Suffolk.
1905. HANSON, Clarence Oldham, Deputy Conservator, Indian Forest Department, Latimer Lodge, Littledean Hill, Newnham, Gloucestershire.
*1903. HARDIE, David, Factor, Errol Park, Errol.
1903. *Hardy, Marcel Edgard, Assistant for Botany, University College, Dundee.*

Date of Election.

*1880. HARE, Colonel, Blairlogie, Stirling.
*1896. *Harley, Andrew M., Forester*, 37 *Hemd*
Reading.
1906. HARPER, Peter, Superintendent, Duthie Park
1905. HARROW, R. L., Head Gardener, Royal Botar
1897. HARROWER, William, Forester, Garth, Aberf
1897. HART, John, Factor, Mains of Cowie, Stoneh
*1880. HAVELOCK, W. B., The Nurseries, Brocklesb
1897. HAY, Alexander, of Ben. Reid & Co., Nursery
1905. HAY, Henry Ferguson, Assistant Forester,
Bakewell, Derbyshire.
1892. HAY, John, Overseer, Dollars Estate Of
Kilmarnock.
1904. HAY, Sir Duncan Edwyn, Bart. of Haystou
London, S.W.
1906. HAY, Thomas, Head Gardener, Hopetoun Hc
1905. HAY, William Black, Assistant Forester, 8 Re
1896. HAY, Wm. P., Merchant, Rosebank, Loanhe
1889. HAYES, John, Overseer, Dormont, Lockerbie
1869. HAYMAN, John, Glentarff, Ringford, Kirkcuc
1902. HAYNES, Edwin, Editor *Timber Trades J*
Street, London.
1904. HAYWARD, Henry, Land Agent, St Margaret
1906. HENDERSON, Henry, Overseer, Bantaskine, I
1901. HENDERSON, Peter, Factor, Ballindalloch.
1893. HENDERSON, R., 4 High Street, Penicuik, Mi
1893. HENDERSON, William, Forester, Clonad Cot
County.
*1906. HENDRICK, James, B.Sc., F.I.C., Marischal (
1898. HENDRY, James, 5 Thistle Street, Edinburgh
*1901. HEPBURN, Sir Archibald Buchan-, Bart.
Prestonkirk.
*1874. HERBERT, H. A., of Muckross, Killarney, Co
*1884. HEYWOOD, Arthur, Glevering Hall, Wickhar
1895. HILL, Claude, of Messrs John Hill & Sons, Spo
Staffordshire.
1904. HILL, George, Assistant Forester, Fothringha
*1904. HILL, J. Smith, The Agricultural College, As
*1903. HILL, Robert Wylie, of Balthayock, Perthsh
*1905. HILLIER, Edwin L., F.R H.S., Nurseryman a
Culross, Winchester.
*1902. HINCKES, Ralph Tichborne, J.P., D.L., Foxl
1906. HISLOP, Robert, Assistant Forester, Chatswor
1895. HOARE, Sir Henry Hugh Arthur, Bart. of Stc
1903. HODSON, Richard Edmund, Land Agent, Coc
Co. Cork.
1866. HOGARTH, James, Forester, Culhorn, Stranra
1905. HOGG, Richard, Estate Overseer, Glenapp, Ba

Date of Election

*1905. HOLMS, John A., Formaken, Erskine, Renfrewshire.
*1902. HOOD, Thomas, jun., Land Agent, Bogend, Duns.
*1871. HOPE, H. W., of Luffness, Drem, Haddingtonshire.
*1876. *Horne, John, Director, Forests and Gardens, Mauritius.*
*1876. HORSBURGH, John, Aberdour House, Aberdour, Fife.
1902. HOWE, John Arnold, Assistant Forester, Kippendavie, Dunblane.
1905. HUDSON, W. F. A., M.Á., Lecturer on Forestry, Agricultural College, Glasgow.
1876. HULL, Frank, Forester, Lilleshall, Newport, Salop.
1905. HUTTON, George Kerse, Assistant Forester, Castle Kennedy, Wigtownshire.
1906. HUTTON, James, Head Forester, Glendye, Banchory.

1905. IMRIE, Charles, Assistant Forester, Dean Road, Kilmarnock.
1901. IMRIE, James, Assistant Forester, Knowsley, Prescot, Lancashire.
*1884. *Inglis, Alex., Greenlaw Dean, Greenlaw, Berwickshire.*
1904. INGLIS, David, Accountant, National Bank, Allanmore, Abbotshall Road, Kirkcaldy.
1897. INGLIS, George Erskine, Estate Agent, Campbeltown, Argyleshire.
1891. INGLIS, William, Forester, Brodick, Isle of Arran.
1895. INNES, Alexander, Forester, Drummuir, Keith.
1904. INNES, Alexander Berowald, of Raemoir and Dunnottar, Raemoir House, Banchory.
1906. INNES, James, Wood Merchant, Sundayswells Saw-mills, Torphins.
1906. INNES, Lieut.-Colonel Francis Newell, Learney, Torphins, Aberdeen.
*1906. IRVINE, Alexander Forbes, J.P., B.A. (Oxon.), Drum Castle, Aberdeen.
1904. IRVINE, Cosmo Gifford, Assistant Forester, Hollycombe Estate, c/o Mrs Luckins, Wardley Marsh, Liphook, Hants.
1901. IRVINE, John, Assistant Forester, Colesborne, Cheltenham, Gloucestershire.
1906. IRVING, James Rae Anderson, Assistant Forester, Mainhouse, Kelso.

1893. JACK, George, S.S.C., Dalkeith, Midlothian.
1902. JACK, Thomas, Farmer, Hermiston, Currie.
*1906. JACKSON, George Erskine, B.A. (Oxon.), W.S., Kirkbuddo, Forfar.
1895. JAMIESON, Andrew, Overseer, Carnbroe, Bellshill.
1898. JAMIESON, James, Forester, Ffairfach Nurseries, Golden Grove Estate, Llandilo, South Wales.
1896. JARDINE, Sir R. W. B., Bart. of Castlemilk, Lockerbie, Dumfriesshire.
1904. JOANNIDES, Pericles, Student of Forestry, 46 Minto Street, Edinburgh.
1901. *Johnston, Andrew Reid, Assistant Forester, c/o Mrs Vickers, Pilsley, Bakewell.*
1900. *Johnston, David, Manager, Charlestown Limeworks, Fife.*
1899. JOHNSTON, Edward, Forester, Dalquharran, Dailly, Ayrshire.
*1901. JOHNSTON, James, F.S.I., Factor, Alloway Cottage, Ayr.
*1883. JOHNSTON, Robert, Forester, Bon Ryl Estate, Duns, Berwickshire.

Date of Election.

*1905. LAMONT, Norman, M.P., of Knockdow, Toward, Argyleshire.
*1906. LANGLANDS, James H., Cunmont House, by Dundee.
*1896. LANSDOWNE, The Most Hon. the Marquess of, K.G., 54 Berkeley Square, London, S.W.
1906. LAUDER, Alexander, D.Sc., Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh.
1901. LAUDER, William, Steward, Summerhill House, Enfield, Co. Meath.
1897. LAURISTON, John, Assistant Forester, 13 Weekley, Kettering, Northamptonshire.
1906. LAWSON, William, Assistant Factor, Cromartie Estates, Kildary, Ross-shire.
1902. LEARMONT, John, Nurseryman, Larchfield Nurseries, Dumfries.
1904. LEES, D., of Pitscottie, Cupar, Fife.
1905. LEES, Ernest A. G., Assistant Factor, Durris Estate, by Aberdeen.
*1876. LEICESTER, The Right Hon. the Earl of, Holkham Hall, Wells, Norfolk.
1874. LEIGH, William, of Woodchester Park, Stonehouse, Gloucestershire.
1880. LEISHMAN, John, Manager, Cavers Estate, Hawick, Roxburghshire.
*1868. LESLIE, Charles P., of Castle-Leslie, Glaslough, Ireland.
*1893. LEVEN, George, Forester, Auchincruive, Ayr.
*1881. LEYLAND, Christopher, Haggerston Castle, Beal, Northumberland.
1898. *Leys, Wm. B., Forester, Colstoun Old Mill, Gifford, East Lothian.*
1879. LINDSAY, Robert, Kaimes Lodge, Murrayfield, Midlothian.
1880. LINLITHGOW, The Most Hon. the Marquis of, Hopetoun House, South Queensferry.
1906. LOCKHART, Archibald, Wood Merchant, Huntly.
1905. LOGAN, David, Factor, Saltoun, Pencaitland.
*1883. LONEY, Peter, Estate Agent, 6 Carlton Street, Edinburgh.
1906. LONGMUIR, Alexander Law, Assistant Forester, Denhead, Fern, Brechin.
*1881. LONSDALE, Claud, Rose Hill, Carlisle.
*1898. LOVAT, The Right Hon. Lord, C.B., D.S.O., Beaufort Castle, Beauly, Inverness.
*1880. *Love, J. W., c/o Mrs Boyce, Byron Street, St Kilda, Victoria, South Australia.*
*1875. LOVELACE, The Right Hon. the Earl of, East Horsley Towers, Woking, Surrey.
1898. LOW, James, Forester, Innes Estate, Elgin.
*1900. LOW, William, B.Sc., Tighnamuirn, Monifieth.
1906. LUMSDEN, David, Assistant Forester, Kingswood, Murthly.
*1891. LUMSDEN, Hugh Gordon, of Clova, Lumsden, Aberdeenshire.
1900. LUMSDEN, Robert, jun., 11 Morningside Terrace, Edinburgh.
*1875. LUTTRELL, George F., of Dunster Castle, Taunton, Somersetshire.
*1900. LYELL, Sir Leonard, Bart. of Kinnordy, Kirriemuir.

1906. MACALPINE-LENY, Major R. L., of Dalswinton, Dumfriesshire.
1902. MACARTHUR, William, Assistant Forester, Queen Street, Waddesdon, Aylesbury, Buckinghamshire.
1892. MACBEAN, Simon, Land Steward, Erskine, Bishopton.

Date of Election.

1899. M'Gregor, Archibald, Forester, Airthrey Castle, Bridge of Allan.
*1906. MacGregor, Evan Malcolm, Factor, Ard Choille, Perth.
1901. *M'Gregor, Robert, Forester, Rossie Priory, Trottick, Inchture.*
1904. M'Haffie, John A., Saw-mill Manager, 19 Horace Street, St Helens, Lancashire.
1899. M'Hardy, Alexander, The Castle, Inverness.
1905. M'Hardy, James, Assistant Forester, c/o Mrs M'Donald, Bridgend, Craigmillar.
1906. M'Hardy, Peter, Seedsman, 11 Howburn Place, Aberdeen.
1904. M'Hardy, William, Forester, Chancefield, Falkland, Fife.
1901. MacHattie, John W., City Gardener, City Chambers, Edinburgh.
1894. M'Ilwraith, Wm., Forester, Egton, Grosmont R.S.O., Yorks.
1905. M'Intosh, Alexander, Assistant Forester, Benmore, Kilmun.
*1895. Macintosh, D. L., The Gardens, Stronvar, Lochearnhead.
*1879. M'Intosh, Dr W. C., Professor of Natural History, University of St Andrews, 2 Abbotsford Crescent, St Andrews.
1904. M'Intosh, Robert, Forester, Cullentragh Cottage, Rathdrum, Co. Wicklow.
*1885. MacIntosh, William, Fife Estates Office, Banff.
1901. Macintosh, William, Forester, New Chapel, Boncath R.S.O., South Wales.
1905. M'Intyre, Archibald, Timber Merchant, Glenlee, Cardoss.
1898. Mackay, Æneas J. G., LL.D., Advocate, 2 Albyn Place, Edinburgh.
1892. M'Kay, Allan, c/o Park & Co., Ltd., Timber Merchants, Fraserburgh.
1865. Mackay, John, Lauderdale Estate Office, Wyndhead, Lauder.
1899. M'Kay, John, Assistant Forester, Golspie Saw-mills, Golspie.
1887. Mackay, Peter, Forester and Overseer, Bargany Mains, Dailly, Ayrshire.
1900. M'Kechnie, Angus, Assistant Forester, Walkergate, Alnwick.
1891. Mackendrick, James, Forester, Pallas, Loughrea, Co. Galway.
1867. Mackenzie, Alex., Warriston Nursery, Inverleith Row, Edinburgh.
1901. Mackenzie, Charles, Assistant Factor, Mortonhall, Liberton.
1901. M'Kenzie, Daniel, Forester, Wynyard Estate, Stockton-on-Tees.
*1872. Mackenzie, Donald F., F.S.I,, Estate Office, Mortonhall, Edinburgh.
*1893. Mackenzie, James, Forester, Cullen House, Cullen.
1899. M'Kenzie, James, Wood Merchant, Inverness.
1897. Mackenzie, John, Assistant Forester, Waukmill, Old Scone, Perth.
1904. Mackenzie, Major E. Walter Blunt, Castle Leod, Strathpeffer.
1904. Mackenzie, Sir Alexander Muir, Bart. of Delvine, c/o Messrs Condie, Mackenzie & Co., W.S., Perth.
1900. Mackenzie, Sir Kenneth John, Bart. of Gairloch, 10 Moray Place, Edinburgh.
1896. Mackenzie, Wm., Forester, Novar, Evanton, Ross-shire.
1905. M'Kerchar, John, Commercial Traveller and Seedsman, 35 Giesbach Road, Upper Holloway, London, N.
*1897. *M'Kerrow, Robert, Manager, Carton, Maynooth, Co. Kildare.*

Date of Election.

*1876. MARTIN, James, Forester, Knipton, Grantham, Lincolnshire.
*1884. MASSIE, W. H., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1906. MASTERTON, James, Wood Merchant, 4 Windsor Street, Edinburgh.
1893. MATHER, R. V., of Laing & Mather, Nurserymen, Kelso.
1901. MATTHEWS, Robert, Land Steward, Duncrub Park, Dunning.
*1894. MAUGHAN, John, Estate Agent, Jervaulx Abbey, Middleham R.S.O., Yorks.
1896. MAXTONE, John, Forester, Duff House, Banff.
*1904. MAXWELL, Aymer, Yr. of Monreith, Wigtownshire, Lieutenant, Grenadier Guards.
1891. MAXWELL, James, Forester and Overseer, Ruglen, Maybole.
*1893. MAXWELL, Sir John Stirling-, Bart. of Pollok, Pollokshaws.
1886. MAXWELL, The Right Hon. Sir Herbert E., Bart. of Monreith, Port William, Wigtownshire.
1905. MAXWELL, William Jardine Herries, of Munches, Dalbeattie.
1904. MEADE, Richard Y. E., B.A., Land Agent, Estate Office, Dunchurch, Rugby.
*1879. MEIKLE, R. A., Woodbrae, Eskbank.
1896. MEIKLEJOHN, John J. R., Factor, Novar, Evanton, Ross-shire.
1906. MELDRUM, Thomas C., Nurseryman, Forfar.
1899. MELVILLE, David, The Gardens, Dunrobin Castle, Golspie.
1901. MENZIES, James, Assistant Forester, The Mill, Castlecomer, Co. Kilkenny.
*1880. MESHAM, Captain, Pontryffydd, Bodvari, Rhyl, Denbighshire.
1906. MESTON, William, Assistant Forester, Tower Cottage, Durris, Aberdeen.
1877. METHVEN, Henry, of Thomas Methven & Sons, 15 Princes Street, Edinburgh.
1869. METHVEN, John, of Thomas Methven & Sons, Leith Walk Nurseries, Edinburgh.
1892. METHVEN, John, The Gardens, Blythswood, Renfrewshire.
*1881. MICHIE, John, M.V.O., Factor, Balmoral, Ballater, Aberdeenshire.
1893. MICHIE, William, Forester, Welbeck, Worksop, Notts.
1904. MICKEL, F. Ord, Wood Merchant, Upper Bonnington, Linlithgow.
*1893. MIDDLEMASS, Archibald, Forester, Tulliallan, Kincardine-on-Forth.
1905. MIDDLETON, James, Factor, Braehead House, Kilmarnock.
1906. MIDDLETON, John, Wood Merchant, Aboyne.
*1905. MILLAR, John, Timber Merchant, Greenhaugh Saw-mills, Govan.
1905. MILLER, Lewis, of Corriegour, Inverness-shire, and Timber Merchant, Benochie, Crieff.
1882. MILNE, Alex., of James Dickson & Sons, 46 Hanover Street, Edinburgh.
1899. MILNE, Alexander, Factor, Urie Estate Office, Stonehaven.
1902. MILNE, Alexander, Forester, Charboro' Park, Blandford, Dorset.
1903. MILNE, Colonel George, of Logie, Aberdeenshire.
1906. MILNE, David, Photographer, 158 King Street, Aberdeen.
1904. MILNE, Frederick, Assistant Forester, Innerbuist Cottage, Stormontfield, Perth.
1895. MILNE, James, Land Steward, Carstairs House, Carstairs.
1906. MILNE, John, Assistant Forester, Woodlands, Durris, Aberdeen.

Date of Election.

1906. MUNRO, Donald, Wood Merchant's Manager, Ravenswood, Banchory.
1902. MUNRO, George A., S.S.C., 6 Rutland Square, Edinburgh.
*1902. MUNRO, Hugh Thomas, Lindertis, Kirriemuir.
1905. MUNRO, Sir Hector, Bart. of Foulis Castle, Evanton, Ross-shire.
1903. *Murdoch, Robert, Overseer, Bertha, by Perth.*
1892. MURRAY, Alexander, Forester, Murthly, Perthshire.
1902. MURRAY, Bailie John, J.P., 11 Strathearn Road, Edinburgh.
1904. MURRAY, Charles A., of Taymount, Stanley.
1901. MURRAY, David, Gardener, Culzean Gardens, Maybole.
1906. MURRAY, David, Assistant Forester, Windsor Cottage, Fern, by Brechin.
1900. MURRAY, George J. B., Assistant Forester, The Glen, Innerleithen.
1905. MURRAY, James, Farmer, Outerston, Gorebridge.
1900. MURRAY, John C., F.S.I., Factor and Commissioner, Haggs Castle, Glasgow.
1904. MURRAY, John M., Assistant Forester, 26 Colville Place, Edinburgh.
1900. MURRAY, William, of Murraythwaite, Ecclefechan, Dumfriesshire.
*1896. MURRAY, William Hugh, W.S., 48 Castle Street, Edinburgh.

1904. NAIRN, Robert, Forester, Rowallan, Kilmarnock.
*1899. NAIRN, Sir Michael B., Bart. of Rankeillour, Manufacturer, Kirkcaldy.
*1905. NASMYTH, Norman, of Glenfarg, Glenfarg Lodge, Abernethy.
1894. NEIL, Archibald, Forester, Warkton, Kettering, Northamptonshire.
1893. NELSON, Robert, Assistant Forester, Hannahgate Cottage, Kinmount Estate, Cummertrees, Dumfriesshire.
1895. NEWTON, George, 28 Charlotte Square, Edinburgh.
1893. NICOL, James, Forester, Aird's Mill, Muirkirk, Ayrshire.
1895. NICOL, James, Forester, Croxteth, Liverpool.
1906. NICOL, William, Forester, Cluny Castle, Ordhead, Aberdeenshire.
*1903. NICOL, William Edward, D.L., J.P., of Ballogie, Aboyne.
1901. NICOLL, William Peter, Assistant Forester, Kippo, Kingsbarns, Fife.
*1901. NICOLSON, Edward Badenach, Advocate, 4 Atholl Crescent, Edinburgh.
*1893. NISBET, J., D.Œc., Royal Societies' Club, 63 St James Street, London, S.W.
*1902. NISBET, Robert C., Farmer, Kingsknowe, Slateford.
1898. NISBETT, J. L. More, of The Drum; New Club, Edinburgh.
*1899. NOBBS, Eric Arthur, B.Sc., Department of Agriculture, Cape Town.
1899. NOBLE, Charles, Forester, Donibristle, Aberdour.
1904. NOBLE, Hugh, Assistant Forester, Cothall, Altyre, Forres.

1906. OGILVIE, Thomas, D.L., J.P., Kepplestone, Aberdeen.
1900. OLIPHANT, Joseph, Assistant Forester, Quarterbank, Abercairney, Crieff.
*1894. ORKNEY, William C., Surveyor's Office, Montrose Royal Asylum.
*1899. ORR-EWING, Archibald Ernest, Ballikinrain Castle, Balfron.
*1906. ORR, George W., Cowdenhall, Neilston.
1906. ORR, Harry D., Timber Merchant, 73 Saltergate, Chesterfield.
1902. OSWALD, Richard Alexander, of Auchincruive, Ayr.
1906. OWEN, Harry, Assistant Forester, Chatsworth, Pilsley, Bakewell.

Date of Election.

1870. RATTRAY, Thos., Forester, Westonbirt House, Tetbury, Gloucestershire.
1905. REID, Alexander T., Assistant Forester, Royal Botanic Garden, Edinburgh.
1905. REID, Andrew, The Gardens, Durris, Drumoak, Aberdeenshire.
1901. REID, Hugh, Forester, Ashton Court, Long Ashton, near Bristol.
1894. REID, James S., Forester, Balbirnie, Markinch, Fife.
1900. REID, John, Estate Overseer, The Mains, Lochgelly.
1906. REID, Richard, Assistant Forester, Sunlaws Hill, Roxburgh.
1905. REID, Robert, Overseer, Kincairney, Dunkeld.
1903. REID, Robert Matelé, Thomanean, Milnathort.
1901. RENNIE, Joseph, Overseer, Hillend, Possil, Maryhill.
*1873. RICHARDSON, Adam D., 1 West Brighton Crescent, Portobello.
1892. RITCHIE, Alexander, Overseer, Brucehill, Cardross Estate, Port of Menteith.
*1876. RITCHIE, William, Hope Lodge, Moffat.
1898. RITCHIE, Wm., Assistant Forester, Moss-side Cottage, Lynedoch, Perth.
1906. RITCHIE, William Hamilton, of Dunnottar, Dunnottar House, Stonehaven.
1906. ROBB, Archibald, Riverslea, Rothes.
1900. ROBB, John, Road Surveyor, County Buildings, Edinburgh.
1904. ROBERTSON, Alexander, Assistant Forester, Meikledams, Durris.
*1897. ROBERTSON, A. Barnett, Forester, The Dean, Kilmarnock, Ayrshire.
1897. ROBERTSON, Andrew N., Forester, Glenferness, Dunphail.
1899. ROBERTSON, Charles, Forester, Colstoun Old Mill, Gifford.
*1879. ROBERTSON, Donald, Forester, Dunrobin, Golspie.
1896. ROBERTSON, George, Forester, Ponsbourne Park Estate, near Hertford.
1900. ROBERTSON, James, Assistant Forester, Garth, Fortingall, Aberfeldy.
1904. ROBERTSON, James, Assistant Forester, Pollok Estate, Pollokshaws.
1904. *Robertson, James, Forester, Ardmulchan, Navan, Co. Meath.*
*1866. ROBERTSON, Jas., Wood Manager, Panmure, Carnoustie, Forfarshire.
*1905. ROBERTSON, James Morton, of Cowieslinn, Portmore House, Eddleston.
1905. ROBERTSON, James W., Head Gardener, Letham Grange and Fern, Arbroath.
*1905. ROBERTSON, John, Factor, Panmure Estates Office, Carnoustie.
1896. ROBERTSON, John, Forester, Altyre, Forres.
1902. ROBERTSON, John, 136 George Street, Edinburgh.
1902. ROBERTSON, R. A., M.A., B.Sc., Lecturer on Botany, University, 119 South Street, St Andrews.
1906. ROBERTSON, Robert Mackenzie, Assistant Forester, Chatsworth, Pilsley, Bakewell.
1895. ROBERTSON, Thomas, Forester and Bailiff, Woodlawn, Co. Galway.
1883. ROBERTSON, William, Assistant Forester, Ringwood, Birnam, Perth.
1902. ROBINSON, Stewart, Lynhales, Kington, Herefordshire.
*1890. ROBINSON, William, Gravetye Manor, East Grinstead, Sussex.
1899. ROBSON, Alex., of Smith & Son, 18 Market Street, Aberdeen.
1901. ROBSON, Alexander, Head Gamekeeper, The Kennels, Culzean, Maybole.

Date of Election.

*1898. SHEPPARD, Rev. H. A. Graham-, of Rednock, Port of Menteith, Stirling.
*1903. SHIEL, James, Overseer, Abbey St Bathans, Grant's House.
1905. SHIELDS, James, Farmer, Longniddry.
1905. SIM, John, Forester, Fernybrae, Cornhill, Banffshire.
1903. SIMON, Thomas, jun., Assistant Forester, Montrave, Leven.
1887. SIMPSON, Anthony, Dropmore, Maidenhead, Bucks.
1894. SIMPSON, James, Nurseryman, Dundee.
1906. SINCLAIR, Robert, Factor for North Harris, Harris, by Portree.
1900. SINGER, John G., Forester, Newe Estates, Strathdon, Aberdeenshire.
1868. SLATER, Andrew, Estate Office, Durrington, Salisbury, Wilts.
1899. SLEIGH, Charles W., M.A., Factor, Blackwood Estate Office, Lesmahagow.
1902. SMART, John, Merchant, 18 Leith Street, Edinburgh.
1901. SMITH, Allan, Land Steward, Dunira, Comrie.
*1893. SMITH, Charles G., Factor, Haddo House, Aberdeen.
1906. SMITH, Douglas, P.A.S.I., Land Agent, Estate Office, Stanage Park, Brampton Bryan, Herefordshire.
1904. SMITH, D. D., Nurseryman and Seed Merchant, St Catherine's Street, Cupar, Fife.
1904. SMITH, F. H. Osmond, Surveyors' Institution, Westminster, S.W.
1873. SMITH, G. B., Wire Fence Manufacturer, Craighall Ironworks, Glasgow.
1901. SMITH, James, Forester, 1 Oxmantown Mall, Birr, King's County.
1906. SMITH, James Fraser, F.R.H.S., late Gardener, Barons Hotel, Auchnagatt.
1895. SMITH, John, Cabinetmaker, 1 Eastgate, Peebles.
1901. SMITH, Matthew, Manager for Dyer & Co., Peebles.
1901. SMITH, Sydney, Factor, Drummuir Estates Office, Keith.
1901. SMITH, Thomas, Factor, The Castle, Maybole.
*1895. SMITH, Thomas, Overseer, The Nursery, Tring Park, Wiggington, Tring, Herts.
1896. SMITH, William, Forester, Camperdown, Dundee.
1899. SMITH, William, Overseer, Fairnalee, Selkirk.
*1896. SMITH, William G., B.Sc., Ph.D., Lecturer on Botany, University of Leeds.
*1882. SMYTHE, David M., of Methven Castle, Perth.
1906. SMYTHE, George Henderson, late Gardener, Balcarres Hotel, Echt, Aberdeenshire.
*1889. SOMERVILLE, Dr William, M.A., D.Sc., D.Œc., F.R.S.E., Professor of Rural Economy, Oxford.
1906. SOMERVILLE, Hugh Christopher, Glencairn, Dalkeith.
1906. SOMERVILLE, Robert Anderson, Eastwoodbrae, Dalkeith.
1904. SOUTAR, William, Forester, The Farm, Titsey Place, Limpsfield, Surrey.
1904. SPARKE, Norman Lush, Shanghai Land Investment Company, 2 Jin Kil Road, Shanghai, China.
1898. SPENCE, William, Forester, Strathenery, Leslie.
*1899. SPIERS, Adam, Timber Merchant, Warriston Saw-mills, Edinburgh.

Date of Election.

1904. TAYLOR, Robert, Assistant Forester, Chapelhill, Logiealmond, Methven.

1905. TAYLOR, Robert, Forester, Broomhall Estate, Charlestown, Fife.

1897. TAYLOR, William, Forester, Sandside, Kirkcudbright.

1905. TELFER, John, Assistant Forester, Heckfield, Winchfield, Hants.

*1891. TENNANT, Sir Edward P., Bart. of The Glen, 31 Lennox Gardens, London, S.W.

*1877. TERRIS, James, Factor, Dullomuir, Blairadam, Kinross-shire.

1904. THOMPSON, Dugald, Forester, Drimsynie, Lochgoilhead.

1893. THOMSON, David W., Nurseryman, 113 George Street, Edinburgh.

1903. THOMSON, John Burnside, Estate Manager, Calderwood Castle, High Blantyre

*1855. THOMSON, John Grant, Wood Manager, Grantown, Strathspey.

*1902. THOMSON, Peter Murray, S.S.C., 5 York Place, Edinburgh.

1903. THOMSON, Robert, Foreman Forester, Park Hill, Ampthill, Bedfordshire.

*1901. THOMSON, Spencer Campbell, of Eilean Shona, 10 Eglinton Crescent, Edinburgh.

1904. THREIPLAND, Captain W. Murray, Fingask Castle, Perthshire.

1906. TINDAL, Robert, Forester, Bellspool Cottages, Stobo.

1901. TIVENDALE, William D., Head Forester to Duke of Portland, Burnhouse, Galston.

*1871. TOMLINSON, Wilson, Forester, Clumber Park, Worksop, Notts.

1906. TOSH, Hendry, Assistant Forester, Bogie, Fern, Brechin.

1906. TOUGH, George, F.E.I.S., Teacher, Kirkhill, Nigg, Aberdeen.

*1906. TRAIL, James William Helenus, A.M., M.D., F.R.S., Professor of Botany in University of Aberdeen, 71 High Street, Old Aberdeen.

*1902. TROTTER, A. E. C., of Bush, Milton Bridge, Midlothian.

*1903. TULLIBARDINE, The Most Hon. the Marquis of, D.S.O., Blair Castle, Blair Atholl.

1900. *Tully, James B., Assistant Forester, Hope Vlei Estate, Bloemfontein, O.R. Colony.*

1900. TURNBULL, Andrew, Assistant Forester, Picktree, Chester-le-Street, Co. Durham.

1903. TURNBULL, John, Assistant Forester, Dumfries House, Cumnock.

1901. TURNER, Joseph Harling, Agent for Duke of Portland, Cessnock Castle, Galston.

1898. TWEEDIE, Alexander, Forester, Faskally, Pitlochry.

1883. UNDERWOOD, Henry E., Fornham, St Martin, Bury St Edmunds, Suffolk.

1903. UNWIN, Arthur Harold, D.Œc., Town House, Haslemere, Surrey.

*1872. URQUHART, B. C., of Meldrum, Aberdeenshire.

*1902. URQUHART, Farquhar, Nurseryman, Inverness.

*1903. USHER, Thomas, Factor, Courthill, Hawick.

1903. VEITCH, John, Factor, Fasnacloich.

Date of Election.

1903. WALKER, Captain George Lawrie, of Crawfordton, Thornhill.
*1878. WALKER, Colonel I. Campbell, Newlands, Camberley, Surrey.
1894. WALKER, Henry H., Factor, Monreith, Port William, Wigtownshire.
*1906. WALKER, John Steven, Yard Foreman, Saw-mills, Hurlford, Ayrshire.
*1906. WALKER, Robert Williamson, C.E., Factor and Land Surveyor, 3 Golden Square, Aberdeen.
1870. WALL, G. Y., Land Agent, Grange House, Darlington, Durham.
1903. WALLACE, Andrew, Assistant Forester, Montrave, Leven.
1893. WALLACE, David P., Forester, The Saw-mills, Filleigh, Molton, S. Devon.
*1897. WALLACE, John A. A., of Lochryan, Cairnryan, Stranraer.
1893. WALLACE, Robert B. P., Timber Merchant, 12 Danube Street, Edinburgh.
*1905. WALLACE, Thomas Douglas, F.S.I., Callendar Estate Office, Callendar Park, Falkirk.
1899. WANDESFORDE, R. H. Prior, of Castlecomer, Co. Kilkenny.
*1900. WARWICK, Charles, Land Steward, Clandeboye, Co. Down.
1901. WASON, Eugene, M.P., of Blair, Dailly, Ayrshire; 8 Sussex Gardens, Hyde Park, London.
1903. WATSON, Hugh, Forester, Sunnyside Cottages, Maybole.
1901. WATSON, James, Manager, Moy Hall, Inverness-shire.
1893. WATSON, John, Timber Merchant, Annandale Street, Edinburgh.
*1893. WATSON, John T., 6 Bruntsfield Gardens, Edinburgh.
1872. WATT, James, J.P., of Little & Ballantyne, Nurserymen, Carlisle.
1893. WATT, James W., Knowefield Nurseries, Carlisle.
1889. *Watters, Dennis, Forester, Wester Elchies, Carron, Strathspey.*
1904. WEALE, James A., Timber Merchant, Boundary Place, Liverpool.
1906. WEBSTER, Charles, Gardener and Forester, The Gardens, Gordon Castle, Fochabers.
1902. WEBSTER, Thomas, Overseer, Burdie House, Loanhead.
*1891. WELSH, James, of Dicksons & Co., 1 Waterloo Place, Edinburgh.
*1871. WEMYSS, Randolph Gordon Erskine, of Wemyss and Torrie, Fife.
1904. WENTWORTH-FITZWILLIAM, George Charles, of Milton, Peterborough.
1902. WHELLENS, Henry, Assistant Forester, Raith, Kirkcaldy.
1905. WHITE, Andrew, Forester, Portmore, Eddleston.
*1898. WHITE, J. Martin, Balruddery, near Dundee.
1895. WHITE, William, Farmer, Gortonlee, Lasswade.
1905. WHITTINGHAM, Edwin, Contractor, St Mary's, Newport, Salop.
1884. WHITTON, James, Superintendent of Parks, 249 George Street, Glasgow.
*1899. WHYTE, John D. B., Factor, Estate Office, Elveden, Suffolk.
1901. WHYTOCK, James, The Palace Gardens, Dalkeith.
1895. WIGHT, Alexander, Overseer, Thurston, Innerwick.
*1869. WILD, Albert Edward (Conservator of Forests, Darjeeling, India), c/o Henry S. King & Co., 65 Cornhill, London, E.C.
1883. WILKIE, Charles, Forester, Lennoxlove, Haddington.
1891. WILKIE, G., Architect, Hayfield, Peebles.
1904. WILKINSON, Henry Bevis, Assistant Factor, Holmhead, Corsock, Dalbeattie.

Date of Election.

1902. WILKINSON, John, Factor, The Grange, Kirkcudbright.
1903. WILL, George, Manager, Crichton Royal Institution Farm, Dumfries.
1895. WILLIAMSON, John, Bank Agent, Loanhead, Midlothian.
*1898. WILSON, David, Timber Merchant, Troon, Ayrshire.
*1889. WILSON, David, jun., of Carbeth, Killearn, Glasgow.
1896. WILSON, James, M.A., B.Sc., Royal College of Science, Stephens Green East, Dublin.
1900. WILSON, James, jun., Nurseryman, St Andrews.
1904. WILSON, James Watt, Seedsman and Nurseryman, Perth.
1902. WILSON, John, Airdrie House, Airdrie.
1901. WILSON, John Currie, Factor, Tulliallan Estate Office, Kincardine-on-Forth.
1897. WILSON, John H., D.Sc., F.R.S.E., Lecturer on Agriculture and Rural Economy, The University, St Andrews.
1903. WILSON, Thomas, Head Gardener, Glamis Castle, Glamis.
1899. WILSON, William, Timber Merchant, Auchenleck, Ayrshire.
*1904. WINK, John, Solicitor, High Street, Elgin.
1893. WISEMAN, Edward, Nurseryman, Elgin.
1895. WISEMAN, William, Nurseryman, Forres.
1906. WOLFE, George, sen., J.P., Shovel Manufacturer, Millburn, Bathgate.
1904. WOOD, James, Forester, Marr Doncaster, Yorkshire.
1894. WOOD, William, The Gardens, Newton Don, Kelso, Berwickshire.
1904. WORSFOLD, Edward Mowll, Land Agent, Christ Church Villas, Priory Road, Dover.
1904. WOTHERSPOON, George, Factor, Cromartie Estate Office, Kildary, Ross-shire.
1904. WRIGHT, Robert Patrick, F.H.A.S., F.R.S.E., Principal of West of Scotland Agricultural College, Blythswood Square, Glasgow.
1906. WYLAM, Ralph J., Assistant Forester, Chester Lodge, Lambton Park, *via* Chester-le-Street.
1868. WYLLIE, George, Ballogie, Aboyne, Aberdeenshire.
1906. WYLLIE, William, Seedsman, 18 Market Street, Aberdeen.

1897. YEATS, Alexander, Kwatsi Bay Lumber Co., Vancouver, B.C., Canada.
1904. YOOL, Thomas, Factor, Menzies Estates Office, Aberfeldy.
1904. *Yorke, Maurice Francis, Land Agent's Assistant, 35 New Walk, Leicester.*
1905. YOUNG, John, Hedger, West Lodge, Corehouse, Lanark.
1875. YOUNG, William, Forester, Morriston Cottage, Earlston, Berwickshire.
*1898. YOUNGER, Henry J., of Benmore and Kilmun, Greenock.
*1899. YULE, Miss Amy Frances, L.A., Tarradale House, Muir of Ord.

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UNIV. OF MICH.
JUL 23 1907

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

VOL. XX.—PART II.

July 1907.

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Royal Scottish Arboricultural Society.

INSTITUTED 1854.

Patron—HIS MOST EXCELLENT MAJESTY THE KING.

Permission to assume the title "Royal" was granted by Her Majesty Queen Victoria in 1887.

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The Right Hon. THE EARL OF STAIR.
Sir JOHN HALL, Bart. of Dunglass.
His Grace THE DUKE OF ATHOLL.
JOHN I. CHALMERS of Aldbar.
The Right Hon. THE EARL OF AIRLIE.
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73. HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
75. JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. & E., Professor of Botany in the University of Edinburgh.
78. The Right Hon. W. P. ADAM of Blairadam, M.P.

1879-81. The Most Hon. THE MARQUIS OF LOTHIAN, K.T.
1882. ALEXANDER DICKSON, M.D., F.R.S.E., Hartree, Professor of Botany in the University of Edinburgh.
1883-85. HUGH CLEGHORN, M.D., LL.D., F.R.S.E. of Stravithie.
1886-87. The Right Hon. Sir HERBERT EUSTACE MAXWELL, Bart. of Monreith.
1888-89. The Most Hon. THE MARQUIS OF LINLITHGOW.
1890-93. ISAAC BAYLEY BALFOUR, M.D., Sc.D., F.R.S., LL.D., Professor of Botany in the University of Edinburgh.
1894-97. R. C. MUNRO FERGUSON, M.P.
1898. Colonel F. BAILEY, R.E.
1899-02. The Right Hon. THE EARL OF MANSFIELD.
1903-06. W. STEUART FOTHRINGHAM of Murthly.

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President.

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£584, 3s. 10d. has since been raised by the Society and handed over to the University. Aided by an annual subsidy from the Board of Agriculture, which the Society was mainly instrumental in obtaining, a Course of Lectures at the University has been delivered without interruption since 1889. It is recognised, however, that a School of Forestry is incomplete without a practical training-ground attached to it, which would be available, not only for purposes of instruction but also as a Station for Research and Experiment, and as a Model Forest, by which Landowners and Foresters throughout the country might benefit. The Society has accordingly drawn up a Scheme for the Establishment of a State Model Forest for Scotland which might serve the above-named objects. Copies of this Scheme were laid before the recent Departmental Committee on British Forestry, and in their Report the Committee have recommended the establishment of a Demonstration Area and the provision of other educational facilities in Scotland.

Meantime Mr Munro Ferguson, M.P., for a part of whose woods at Raith a Working-Plan has been prepared, and is now in operation, has very kindly agreed to allow Students to visit them.

Excursions.

During the past twenty-eight years, well-organised Excursions, numerously attended by Members of the Society, have been made annually to various parts of Scotland, England, and Ireland. In 1895, a Tour extending over twelve days was made through the Forests of Northern Germany, in 1902 a Tour extending over seventeen days was made in Sweden, and during the summer of 1904 the Forest School at Nancy and Forests in the north of France were visited. These Excursions enable Members whose occupations necessarily confine them chiefly to a single locality to study the conditions and methods prevailing elsewhere; and the Council propose to extend the Tours during the next few years to other parts of the Continent. They venture to express the hope that Landowners may be induced to afford facilities to their Foresters for participation in these Tours, the instructive nature of which renders them well worth the moderate expenditure of time and money that they involve.

Exhibitions.

A Forestry Exhibition is annually organised in connection with the Highland and Agricultural Society's Show, in which are exhibited specimens illustrating the rate of growth of trees, different kinds of wood, pit-wood and railway timber, insect pests and samples of the damage done by them, tools and implements, manufactured articles peculiar to the district where the Exhibition is held, and other objects of interest relating to Forestry. Prizes and Medals are also offered for Special Exhibits.

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Life, or Ordinary Member, ...

Signature, ...

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[CONDITIONS OF MEMBERSHIP, see Over.

CONDITIONS OF MEMBERSHIP (excerpted from the Laws).

III. Any person interested in Forestry, and desirous of promoting the objects of the Society, is eligible for election as an *Ordinary* Member in one of the following Classes:—

1. Proprietors the valuation of whose land *exceeds* £500 per annum, and others, subscribing annually . . One Guinea.
2. Proprietors the valuation of whose land *does not exceed* £500 per annum, Factors, Nurserymen, and others, subscribing annually . . . . . Half-a-Guinea.
3. Foresters, Gardeners, Land-Stewards, and others, subscribing annually . . . . . Six Shillings.
4. Assistant-Foresters, Assistant-Gardeners, and others, subscribing annually . . . . . Four Shillings.

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Royal Scottish Arboricultural Society.

SYLLABUS OF COMPETITIONS—1907.

[*The Judges are empowered to fix the value of the Prizes to be awarded according to the respective merits of the Essays.*

All Essays, Reports, Models, or other Articles intended for Competition must be lodged with the Secretary not later than 15th May 1907. Each such Essay, Report, Model, or Article must bear a MOTTO, *and be accompanied by a sealed envelope bearing outside the* SAME MOTTO, *with the Class to which the Competitor belongs, and containing a* CARD *with the* NAME *and* ADDRESS *of the Competitor.*

Essays should be written on one side of the paper only; the left-hand quarter of each page should be left as a blank margin. The lines should not be crowded together.

Judges cannot compete during their term of office.

Successful Competitors may have either the medals or their converted values, which are as follows:—Gold, £5; No. 1 *Silver*, £3; No. 2 *Silver*, £2; *Bronze*, 10s.]

The following subjects are named for competition in 1907:—

CLASS I.—FOR OPEN COMPETITION.

I. An account of the Broad-leaved and Coniferous Trees, especially of the more recently introduced Species, which the writer has found from experience to be most suitable as Forest Crops on high and exposed situations. The method under which such a Crop has been raised to be fully described. (*Five Guineas* offered by W. H. MASSIE, Esq., of Messrs Dicksons & Co., Nurserymen, Edinburgh.)

II. Suitability of any exotic Conifer for cultivation as a Forest Crop, and nature of the locality found, in the experience of the writer, to be most suitable for it. (*Five Guineas* offered by DAVID W. THOMSON, Esq., Nurseryman, Edinburgh.)

III. The relative powers to bear shade of some or all of the following species:—Douglas Fir, Menzies Spruce (*Picea sitchensis*), White American Spruce, Balsam Fir, Lawson's Cypress, *Abies grandis*, Hemlock Spruce (*Tsuga Mertensiana*), Canadian Cedar (*Thuya gigantea*); and the order in which the above Species should be placed in a list of shade-bearing trees comprising also Silver Fir, Beech, Spruce. The Report to be based on personal experience only. (*Two Guineas* offered by JOHN METHVEN, Esq., of Messrs Thomas Methven & Sons, Nurserymen, Edinburgh.)

IV. Successful raising, by the writer, or on the Estate with which he is connected, of a Young Forest Crop by the method of "Direct" Sowing. The conditions of Soil and Soil Covering to be fully stated. (*A Medal.*)

V. Comparative results obtained by various methods of Planting, with various Species and Sizes of Plants, up to the time at which the Young Plantation has become thoroughly established. (*A Medal.*)

The Report to be based on actual experience; soil and other local conditions to be fully described.

VI. The use, on an Estate with which the writer is, or has been, connected, of Timber of any British-grown exotic Conifer for House Carpentry and other Estate purposes. (*A Medal.*)

Besides giving information as to the specific uses to which the timber has been put, the writer should give details, such as the age of the trees from which it was taken, the soil on which they were grown, and whether the trees were raised in the open or in woods of ordinary density. Statistics to be given, as far as available, of the comparative durability of this timber and the timber of British coniferous trees.

VII. Details of Measures successfully adopted, on an Estate with which the writer is, or has been, connected, to prevent or mitigate the destructive effects of Gales. (*A Medal.*)

VIII. Successful raising, by the writer, or on the Estate with which he is connected, of a Young Forest Crop in a frosty locality, with details as to Soil Covering, Species, and Measures of Protection adopted. (*A Medal.*)

IX. An approved Report on the Woods of which the competitor is Forester. Reporter to state the extent of the woods, the species of trees grown, soil, situation, age, management, etc. (*A Medal.*)

X. Method adopted by the writer, or on an Estate with which he is, or has been, connected, for getting rid of Refuse Wood, left after Felling, so as to free the ground for the raising of a new crop and reduce risk of fire. (*A Medal.*)

XI. Successful Under Planting of Larch or other Light-crowned Species, on an Estate with which the writer is, or has been, connected. (*A Medal.*)

The Report to be based on experience, the cases referred to being cited.

XII. Details of Measures successfully practised by the writer to exterminate any important Parasitic Fungus, or to mitigate the Damage done by it. (*A Medal.*)

XIII. Details of Mechanical means employed by the writer, or on the Estate with which he is connected, for moving Timber from the interior of Woods to their margins, or to roads. (*A Medal.*)

XIV. The erection and maintenance of a Saw-mill, or any Wood-working Machinery, used by the writer, or on the Estate with which he is connected, for the Manufacture of Timber, with details of outturn and cost. (*A Medal.*)

XV. The best collection of ten short Notes of sylvicultural interest based on personal observation. (*A Medal.*)

XVI. An approved Essay or Report on any other subject connected with Forestry. (*A Medal.*)

Class II.—For Assistant Foresters only.

I. Successful raising, by the writer, or on the Estate with which he is connected, of a Young Forest Crop on ground encumbered by a heavy crop of Weeds. (*A Medal.*)

II. Details of the Measures successfully practised by the writer to exterminate any important Insect Pest, or to mitigate the Damage done by it. (*A Medal.*)

III. The best collection of five Notes of sylvicultural interest based on personal observation. (*A Medal.*)

IV. An approved Essay or Report, based on personal experience, on any practical work connected with Forestry. (*A Medal.*)

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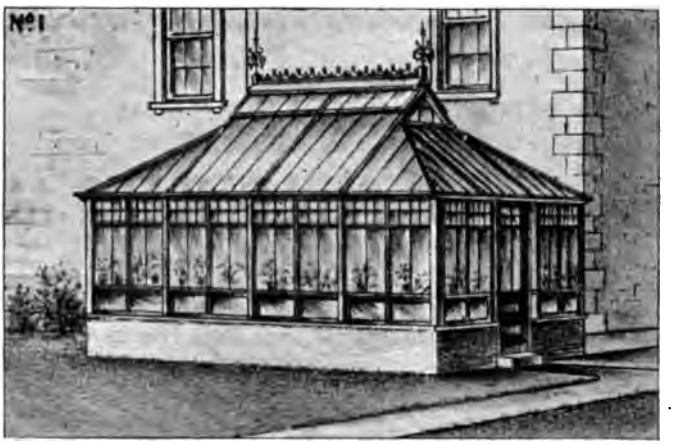

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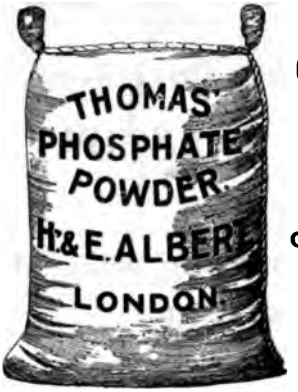

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